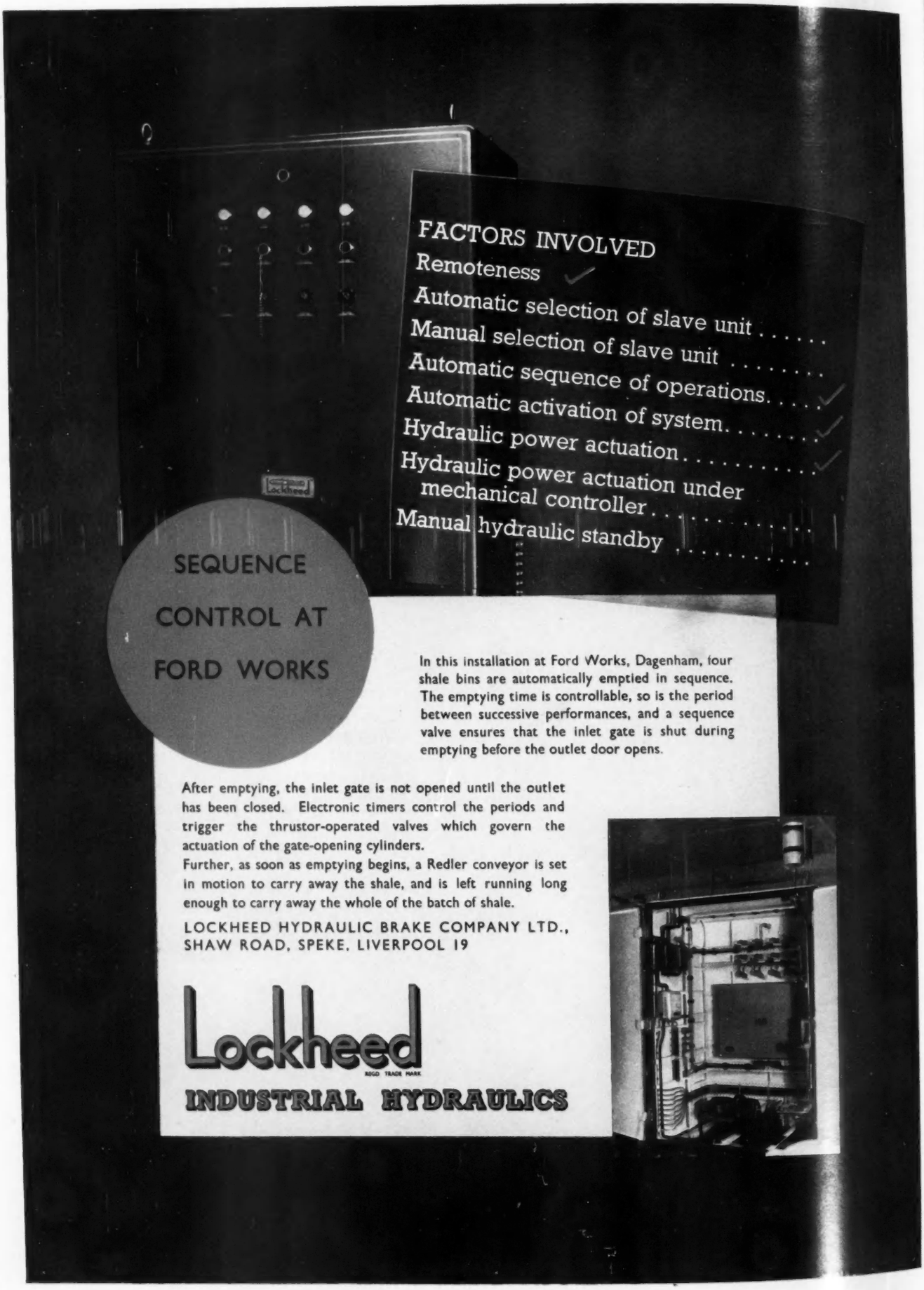
ENGINEERING

An Illustrated Weekly Journal

35 & 36 BEDFORD STREET, STRAND, LONDON, W.C.2 - - TELEPHONE: TEMPLE BAR 3663

Vol. 181 No. 4709 *LONDON, FRIDAY, JUNE* 8, 1956 PRICE 2s.

GAUGING LENGTHS OF AIR CYLINDERS


FACTORS INVOLVED
Remoteness ✓
Automatic selection of slave unit .....
Manual selection of slave unit .....
Automatic sequence of operations.....✓
Automatic activation of system.....✓
Hydraulic power actuation.....✓
Hydraulic power actuation under mechanical controller.....
Manual hydraulic standby .....

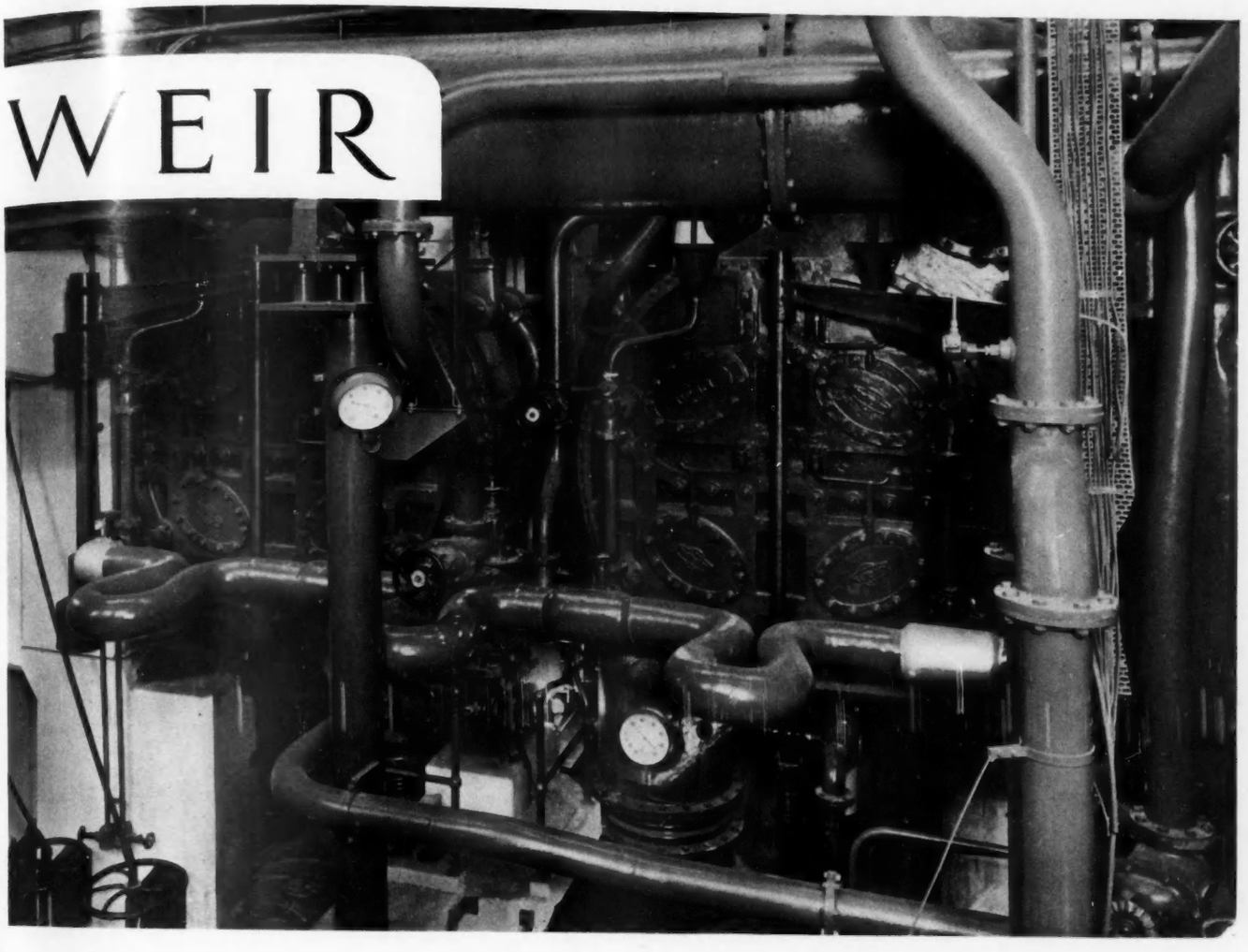
SEQUENCE CONTROL AT FORD WORKS

In this installation at Ford Works, Dagenham, four shale bins are automatically emptied in sequence. The emptying time is controllable, so is the period between successive performances, and a sequence valve ensures that the inlet gate is shut during emptying before the outlet door opens.

After emptying, the inlet gate is not opened until the outlet has been closed. Electronic timers control the periods and trigger the thrustor-operated valves which govern the actuation of the gate-opening cylinders.
Further, as soon as emptying begins, a Redler conveyor is set in motion to carry away the shale, and is left running long enough to carry away the whole of the batch of shale.

LOCKHEED HYDRAULIC BRAKE COMPANY LTD.,
SHAW ROAD, SPEKE, LIVERPOOL 19

Lockheed
REGD. TRADE MARK.
INDUSTRIAL HYDRAULICS



REGENERATIVE CONDENSERS

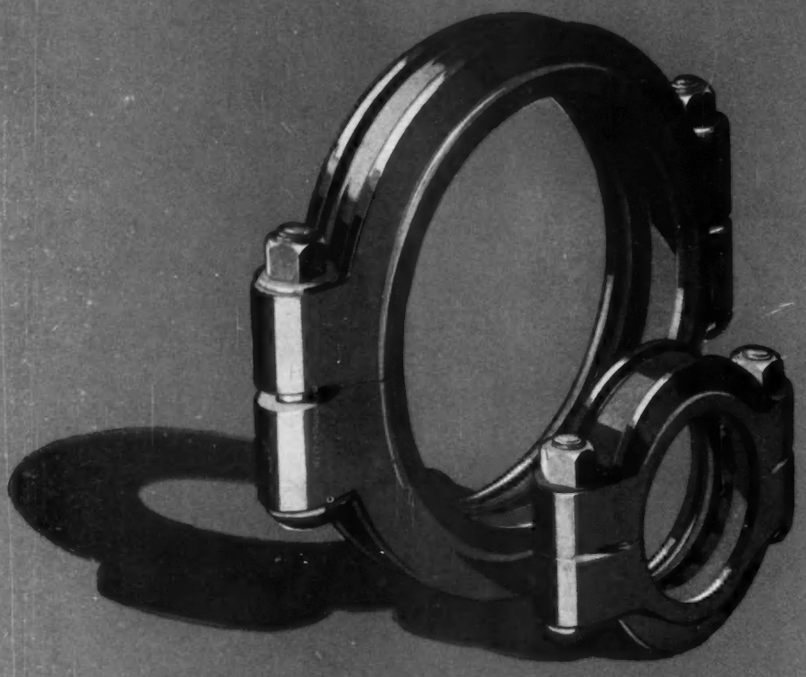
Highest Vacuum

High Condensate Temperature

De-aerated Condensate

Weir Regenerative Condensers are made to our design and under our supervision by leading engineering firms. We welcome consultation on all questions relating to condensing, feed pumping and feed heating, in which we have unrivalled experience.

G. & J. WEIR LTD.
CATHCART : GLASGOW :



VICTAULIC

JOINTS for grooved or shouldered pipes

A positive joint with a valuable amount of angular and longitudinal flexibility.
Rapidly fitted with an ordinary spanner and can be conveniently used in confined spaces
Catalogue on request, kindly state whether grooved steel, shouldered steel, or cast-iron pipes.
Sizes from 1in. to 72in. diameter.

FLEXIBILITY

VIKING JOHNSON

COUPLINGS for plain-ended pipes

Viking Johnson Couplings for plain-ended pipes, whether of steel, iron, or other material.

Angular deflections up to 6°. Accessories can be supplied for completing internal and external protection.

Sizes up to 100″; also ' Junior ' Couplings for ½″ to 2″ Pipes.

THE VICTAULIC COMPANY LIMITED

Manufacturers of Victaulic Joints and Viking Johnson Couplings

BROOK HOUSE, PARK LANE, LONDON, W.1 Telephone : Mayfair 9641

Registered trade marks : ' Victaulic ' and ' Viking '

INDEX TO ADVERTISEMENTS

	PAGE
Abbot Eng'g. Co., Ltd.	20
Accurate Recording Instrument Co.	99
Adamson, Joseph, & Co., Ltd.	102
Air Control Installations, Ltd.	65
Aircraft-Marine Products (G.B.), Ltd.	36
Alexander, G. H., Machinery, Ltd.	100
Alley & MacLellan, (Polmadie), Ltd.	12
Anderton, W. R., & Co. Ltd.	91
Appleby-Frodingham Steel Co.	28
Armstrong Patents Co., Ltd.	92
Armstrong Stevens & Son, Ltd.	10
Atlas Copco Group of Co's	*Wrapper* VII
Automatic Coil Winder & Electrical Equipment, Co., Ltd.	13
Babcock & Wilcox, Ltd.	33
Bailey, Sir W. H., & Co., Ltd.	17
Barclay, Andrew, Sons & Co., Ltd.	8
Barimar, Ltd.	10
Barry, Henry, & Cook, Ltd.	103
Beardmore, W., & Co., Ltd.	45
Beecham Buildings, Ltd.	77
Begg, Cousland & Co., Ltd.	100
Bell, H. (Machine Tools), Ltd.	112
Bigwood, J., & Son, Ltd.	74
Bird, W. H. & Sons Ltd.	8
Booth, Joseph, & Bros.	82
Bridge, David & Co., Ltd.	99
British Electrical Development Assoc.	75
British Ermeto Corp., Ltd.	16
British OxygenLinde, Ltd.	13
British Ropeway Eng'g. Co., Ltd.	105
British Steam Specialties, Ltd.	96
British Thomson-Houston Co., Ltd.	25
British Twin Disc & Clarifiers, Ltd.	100
British Tyre & Rubber Co., Ltd.	103
Broadbent, R., & Son, Ltd.	102
Broom & Wade, Ltd.	*Wrapper* V
Brown, E. G. & Co., Ltd.	106
Brown, Lenox & Co., Ltd.	83
Budenberg Gauge Co., Ltd.	14
Camerer Cuss	96
Carruthers, J. H., & Co., Ltd.	53
Carter, B. & F. & Co., Ltd.	99
Chapman & Hall, Ltd.	5
Chesterfield Tube Co., Ltd.	90
Clyde Blowers, Ltd.	12
Clyde Crane & Booth, Ltd.	82
Clyde Crane & Eng'g. Co.	82
Cohen, Geo., Sons & Co., Ltd.	51 & 90
Constable & Co., Ltd.	3
Conveyor & Elevator Co. (1936), Ltd.	10
Cork Manfng. Co., Ltd.	*Wrapper* VIII
Costain — John Brown, Ltd.	52
Cowans Sheldon & Co., Ltd.	85
Crane Packing, Ltd.	43
Crofts (Engineers), Ltd.	60
Dawson & Downie, Ltd.	102
Delta Metal Co., Ltd.	11
Distington Eng'g. Co., Ltd.	47
Doncaster, Daniel & Sons, Ltd.	59
Dorman Long (Steel) Ltd.	17
Dowty Hydraulic Units, Ltd.	4b
Drum Eng'g. Co., Ltd.	14
Dunlop Rubber Co., Ltd.	42
Edwards, F. J., Ltd.	112
Electric Construction Co., Ltd.	35
Evertaut, Ltd.	104
Farrar Boilerworks, Ltd.	103
Fenner, J. H., & Co., Ltd.	61
Financial Times	34
Finlay Eng'g., Ltd.	19
Firth Brown Tools, Ltd.	101
Firth, Thos., & John Brown, Ltd.	55
Flexible Ducting, Ltd.	21
Ford Motor Co., Ltd.	18
Fordsmith, H., Ltd.	1
Fraser & Fraser, Ltd.	101
Galloway, Geo., & Co., Ltd.	98
General Descaling Co., Ltd.	63
General Electric Co., Ltd.	70
Gilkes, Gilbert, & Gordon, Ltd.	20
Glacier Metal Co., Ltd.	67
Godfrey, Sir Geo. & Partners (Industrial), Ltd.	22
Goodall, Clayton & Co., Ltd.	1
Gordon & Gotch, Ltd.	37
Grafton Cranes, Ltd.	15
Greening, N., & Sons, Ltd.	109
Greenwood & Batley, Ltd.	23
Gwynnes Pumps, Ltd.	73
Halesowen Steel Co., Ltd.	99
Harvey, G. A., & Co. (London), Ltd.	54
Haskins Ltd.	87
Heather Filters, Ltd.	13
Hillman, J. & A., Ltd.	88
Hilmor, Ltd.	14
Hudswell, Clarke & Co., Ltd.	100
Hughes & Lancaster, Ltd.	8
Imperial Chemical Industries, Ltd.	76
International Mechanite Metal Co., Ltd.	80
Jenkins, Robt., & Co., Ltd.	58
Keith Blackman, Ltd.	23
Kingsbourne Products, Ltd.	16
Kitchen & Wade, Ltd.	97
Korting Bros. (1917), Ltd.	110
Lanarkshire Bolt & Rivet Co., Ltd.	106
Levy, B., & Co.	103
Lewis, H. K., & Co., Ltd.	110
Lloyd & Ross, Ltd.	105
Lockheed Hydraulic Brake Co., Ltd.	*Wrapper* II
MacLellan, P. & W., Ltd.	106
McAra Alexander	18
McGraw-Hill Publishing Co., Ltd.	4
Machinoexport	72
Marshall, Sons & Co., Ltd.	68
Massey, B. & S., Ltd.	*Wrapper* VI
Mavor & Coulson Ltd.	30
Mek-Elek Eng'g., Ltd.	101
Metropolitan - Vickers Electrical Co., Ltd.	56 & 78
Modern Mechanisation, Ltd.	100
Modern Wheel Drive, Ltd.	88
Mond Nickel Co., Ltd.	31
Morgan Crucible Co., Ltd.	93
Mulberry Co.	110
Neill, J. & Co. (Sheffield), Ltd.	110
New Conveyor Co., Ltd.	50
Newalls Insulation Co., Ltd.	94
Newbury Diesel Co., Ltd.	100
Norris Bros.	110
Nu-Swift, Ltd.	102
Owl Eng'g. Supplies, Ltd.	19
Parker Foundry (1929) Ltd.	32
Parsons, C. A., & Co., Ltd.	66
Passe, J. F., & Co.	98
Pegler & Louden, Ltd.	104
Philips Electrical, Ltd.	41
Pioneer Oilsealing & Moulding Co., Ltd.	104
Plessey Co., Ltd.	35
Positive Lock Washer Co., Ltd.	104
Power Plant Co., Ltd.	71
Prior Stokers, Ltd.	105
Radiovisor Parent, Ltd.	92
Railway Mine & Plantation Equipment, Ltd.	79
Rawlplug Co., Ltd.	15
Raybestos-Belaco, Ltd.	87
Reavell & Co., Ltd.	15
Reay Gearworks, Ltd.	97
Regent Oil Co., Ltd.	46
Renold Chains, Ltd.	86
Research Engineers, Ltd.	2
Reyrolle, A., & Co., Ltd.	40
Riley, A. J., & Son, Ltd.	94
Robertson, W. H. A. & Co., Ltd.	24
Robson, G. & Co. (Conveyors), Ltd.	101
Rolls-Royce, Ltd.	38 & 39
Rubery Owen & Co., Ltd.	93
Russell, Geo. & Co., Ltd.	101
Ruston-Bucyrus, Ltd.	44
St. George's Engineers, Ltd.	86
Serck, H. O., Ltd.	104
Shaw, W., & Co., Ltd.	14
Sheffield Twist Drill & Steel Co., Ltd.	89
Simmonds Aerocessories, Ltd.	69
Slick Brands, Ltd.	106
Smith, Thos. & Sons (Rodley), Ltd.	62
Smith & McLean, Ltd.	97
Smiths Industrial Instruments Ltd.	64
Sparklets, Ltd.	98
Spencer-Bonecourt-Clarkson, Ltd.	11
Sprax-Sarco, Ltd.	95
Stanley, W. F. & Co., Ltd.	84
Stephens Belting Co., Ltd.	15
Stothert & Pitt, Ltd.	91
Stream-Line Filters, Ltd.	96
Sulzer Bros. (London), Ltd.	29
Sunbeam-Anti-Corrosives, Ltd.	9
Talbot, S. (Engineers), Ltd.	103
Tangyes, Ltd.	21
Taylor & Challen, Ltd.	95
Taylor & Hubbard, Ltd.	99
Telco, Ltd.	111
Town, Fredk. & Sons, Ltd.	108
United Steel Companies, Ltd.	28
Venus Pencil Co., Ltd.	98
Victaulic Co., Ltd.	*Wrapper* IV
Vokes, Ltd.	81
Vulcan Boiler & General Insurance Co., Ltd.	104
Wakefield-Dick Industrial Oils, Ltd.	57
Walker, C. & W., Ltd.	11
Ward, Thos. W., Ltd.	111 & 112
Weir, G. & J., Ltd.	*Wrapper* III
Wellman Bibby Co., Ltd.	12
Wellman Smith Owen Eng'g. Corpn., Ltd.	22
Wellworthy, Ltd.	89
Wickman, Ltd.	26 & 27
Wiggin, H. & Co., Ltd.	49
Wigglesworth, F., & Co., Ltd.	102
Wiseman, A., & Co., Ltd.	88
Wolverhampton Die Casting Co., Ltd.	9
Worthington-Simpson, Ltd.	91
Yarrow & Co., Ltd.	84

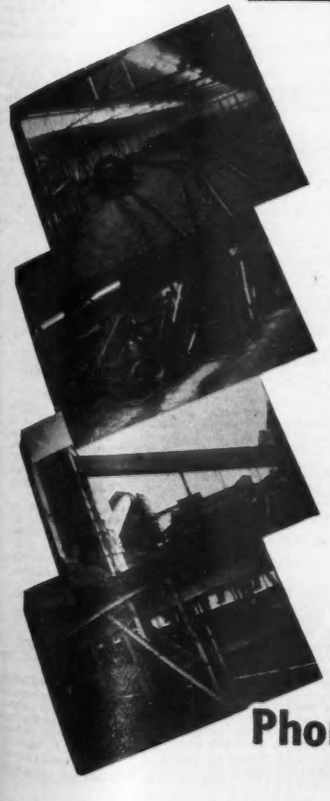
WHEEL KEYS
TAPER & COTTER PINS
COLLARS
BOLTS & NUTS
STUDS
Etc.

FORDSMITH
HADFIELD STREET WORKS
CORNBROOK MANCHESTER 16

Write or 'phone :
TRAfford Park 1615 or 1616
for
ILLUSTRATED BOOKLET
and for our
KEY DATA WALL CHART

F29/2/56.

GOODALL, CLAYTON & Co. LTD.
LEEDS, 10.



ELEVATING & CONVEYING MACHINERY,
COLLIERY SCREENING PLANTS,
PIT HEAD GEARS, HEAPSTEADS,
PICKING BELTS, ROOFS, BUNKERS,
STEEL STRUCTURAL WORK.

Phone: Leeds 75484. "Grams: Vertical Leeds."

CLASSIFIED ADVERTISEMENTS SECTION.

For all advertisements classified under the headings of Tenders, Appointments Open, Situations Wanted, Patent Agents, Partnerships, Wanted, &c., Auction Sales, Publications For Sale, Miscellaneous and Public Notices, &c., the charge will be 12s. for the first four lines or under and 3s. per line up to one inch. When an advertisement measures an inch or more, the charge will be at the rate of 36s. per inch. 5% allowed on 6, 10% on 13, 15% on 26 and 20% on 52 Weekly insertions. If use is made of a box number the extra charge is 2s. per insertion with the exception of advertisements appearing under Situations Wanted. Prospectuses and Notices of Company Meetings £25 per column. Copy instructions must be in our hands first post Monday for the following Friday's Issue. Address to the Manager, ENGINEERING LTD., 35 and 36, Bedford St., Strand, W.C.2. Inclusion of advertisements must be dependent on space being available.

PUBLIC NOTICE.

UNIVERSITY OF GLASGOW.

ASSISTANTSHIP IN AERODYNAMICS.

Applications are invited for an Assistantship in Aerodynamics. Salary scale: £550-£650. Initial salary according to experience and qualifications. F.S.S.U. and family allowance benefits.

Applications (3 copies) should be lodged, not later than 14th July, 1956, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
SECRETARY OF UNIVERSITY COURT.
L 953

EDUCATIONAL.

FREE. Brochure giving details of courses in Mechanical and Production Engineering, Draughtsmanship, etc., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. E.M.I. INSTITUTES, DEPT. EG. 30, LONDON, W.4. (ASSOCIATED WITH H.M.V.) G 619

THE UNIVERSITY OF MANCHESTER.

METROPOLITAN-VICKERS POST-GRADUATE BURSARIES.

Applications are invited from honours graduates in Engineering, Physics or Mathematics for a number of post-graduate bursaries of a value within the range £300-£500 per annum. The bursaries are tenable for research and advanced study in the departments of Electrical and Mechanical Engineering in the Faculty of Science or of Technology. Applications, naming the department and Faculty in which the candidate proposes to work, should be sent not later than July 1st, 1956, to the REGISTRAR, THE UNIVERSITY, MANCHESTER, 13, from whom further particulars and forms of application may be obtained. L 937

COURSES.

CITY OF OXFORD EDUCATION COMMITTEE.

COLLEGE OF TECHNOLOGY ART AND COMMERCE.

SCHOOL OF ENGINEERING,
HEADINGTON ROAD, OXFORD.
(Head: G. E. WALKER, B.Sc. (Lond.), A.T.C. (Stud.), M.I.Mech.E.)

COURSES IN MECHANICAL ENGINEERING.
DIPLOMA COURSE.

This is a three-year Sandwich Course leading to the award of the Higher National Diploma in Mechanical Engineering. Students will attend the College from October to March, the months of April to September being spent in gaining practical experience in industry.

Entry Qualifications: Ordinary National Certificate or its equivalent. Minimum age: 18.

PRELIMINARY COURSE

This is a six months Full Time Course held from October to March. The subjects are similar to those of the Ordinary National Certificate Course, and satisfactory completion of this course will qualify a student for entry to the first year of the Diploma Course.

Entry Qualifications: General Certificate of Education at Ordinary Level in at least four subjects including Mathematics, a suitable Science subject, and preferably English and a foreign language. Minimum age: 16.

For further particulars and forms of application for admission to these courses apply to the HEAD OF THE SCHOOL OF ENGINEERING. Applications should be submitted before 31st July. L 908

ROYAL TECHNICAL COLLEGE,
GLASGOW.

NUCLEAR POWER ENGINEERING

THREE DAY COURSE, 2nd to 4th JULY, 1956.
IN THE ROYAL TECHNICAL COLLEGE
in association with the
INDUSTRIAL GROUP OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY
and the
CENTRAL ELECTRICITY AUTHORITY.

The course is specially designed to give Senior Technical Staff an up-to-date view of the special problems and techniques involved in the application of nuclear power.

Syllabus and enrolment forms from the SECRETARY, ROYAL TECHNICAL COLLEGE, GLASGOW, C.1. L 951

EXPERIMENTAL WORK.

RESEARCH ENGINEERS LIMITED,

Northampton Grove, Canonbury, London, N.1. Canonbury 4244/5/6. We have over 25 years' experience of experimental work and prototypes. We design, develop and manufacture special purpose and labour saving machines, all at the above address. Our range is from the smallest scientific instruments to 3- or 4-ton machines. After a prototype machine has been made and found satisfactory we can manufacture as many as are required. G 656

TENDERS.

THE DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, LONDON, W.3, invites

TENDERS for the supply of:—

"**OXYGEN GAS CYLINDERS,** 300 Nos., governed by R.A.F. Reference No. 71A/202, by A.I.D. approved firms."

Forms of tender, which are returnable by 6th July, 1956, may be purchased at the above address at a cost of 10 shillings.

In your application for tender please quote reference No. 1541/56/H/ENG.2. L 915

STATE ELECTRICITY COMMISSION OF VICTORIA,
22-32, WILLIAM STREET, MELBOURNE, VICTORIA, AUSTRALIA.

The Commission is inviting

TENDERS for the **DESIGN, MANUFACTURE, SUPPLY AND ERECTION OF ASH DISPOSAL PLANT** for its Power Station at Yallourn, Victoria, Australia, in accordance with Specification No. 56-57/4 and B.6 Contract Conditions.

Full particulars are available at the office of the AGENT-GENERAL FOR VICTORIA, VICTORIA HOUSE, MELBOURNE PLACE, STRAND, LONDON, W.C.2.

Tenders endorsed "Tender to Specification No. 56-57/4" are returnable at the Commission's Offices at 22-32, William Street, Melbourne, Victoria, Australia, by 11 a.m. on Wednesday, the 22nd August, 1956.

The Commission does not bind itself to accept the lowest or any tender. L 934

MANCHESTER CORPORATION
WATERWORKS.

TENDERS invited from firms with experience in constructing Reinforced Concrete water retaining structures, for **EXTENSION OF DENTON PURIFICATION PLANT.** The work covers the construction of **ONE FLOCCULATION TANK, SIX SEDIMENTATION TANKS** (total capacity of 330,000 gallons), **PIPEWORK, ETC.**

Tender forms (returnable by 30th June), Specification, Conditions of Contract, Bill of Quantities and Drawings from the SECRETARY, WATERWORKS OFFICES, TOWN HALL, MANCHESTER, 2, on payment of a deposit of two guineas (refunded on receipt of a *bona fide* tender). L 878

METROPOLITAN BOROUGH OF FULHAM.

REFUSE SEPARATION, INCINERATION AND SALVAGE PLANT.

Contractors interested in design and installation of refuse handling and salvage plant at existing destructor are invited to apply for further information from BOROUGH ENGINEER, TOWN HALL, FULHAM, S.W.6.

Plant required to handle 150 tons crude refuse per 8 hour day. Replacement of two four-cell incinerator units by one larger type required; mechanical handling, screening, separation and baling equipment and new waste heat boiler to be supplied and installed.

Contractors to submit own scheme and tender for all plant and work necessary to completion by 31st August, 1956.

CYRIL F. THATCHER,
TOWN CLERK.
TOWN HALL,
FULHAM, S.W.6. L 974

PUBLIC APPOINTMENTS.

MINISTRY OF SUPPLY requires **TECHNICAL ASSISTANT** at Woolwich to assist professional engineers in maintaining factory buildings, roads, railways, piers and wharves; also planning and erecting new works. Qualifications: Recognised apprenticeship or pupilage leading to degree or diploma in the building or civil engineering industry, or A.M.I.C.E. or exempting qualifications. Salary: Within £541-£898 according to age.—Forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (E.), 26, KING STREET, S.W.1, quoting E.168/6/A. L 928

THE BRITISH HYDROMECHANICS RESEARCH ASSOCIATION is building up a school of experts in fluid mechanics who are to be capable of applying academic knowledge, supplemented by research, to a wide range of industrial problems.

The work is interesting and varied, covering flow problems in the process industries, chemical plant, power station and civil engineering structures, etc.; the scientific investigation of rotodynamic machines, cavitation, the hydraulic transport of coal, high pressure hydraulic machinery, automatic controls, and the physics of sliding surfaces in seals and glands.

A few well paid vacancies (£600 to £1000) are available for **YOUNG HONOURS GRADUATES IN ENGINEERING, PHYSICS OR MATHEMATICS** who can take the initiative in applying scientific fluid mechanics to industrial problems, and who preferably have some facility in the lucid exposition of their work. The work of the staff brings them in close contact with both industry and the Universities and opportunities arise from time to time for transfer to senior positions with the Association's member companies. There are also some vacancies for good research assistants with laboratory experience.

Successful applicants will be eligible to rent new houses or flats in Harlow.

Send full details to DIRECTOR OF RESEARCH, BRITISH HYDROMECHANICS RESEARCH ASSOCIATION, HARLOW, ESSEX. G 612

POST OFFICE.

MOTOR TRANSPORT OFFICERS, CLASS III. THE CIVIL SERVICE COMMISSIONERS invite applications from men for two pensionable posts on duties connected with the organisation, maintenance, and control of the Post Office Motor Transport fleet.

Age at least 23 and under 35 years of age on 1st March, 1956, with extension for regular service in H.M. Forces and, up to two years, for established civil service. Candidates must (i) be corporate members of the Institution of Mechanical Engineers or (ii) have passed Sections A and B of the Institution's examinations for corporate membership or hold exempting qualifications, and have had practical experience in a position of responsibility in mechanical and/or automobile engineering.

Starting pay (London) from £611 at age 23 to £1018 at 34 or over. Maximum of scale is £1160. Rates in the provinces somewhat less. Prospects of promotion. Pay and conditions of service under review.

Further particulars and application forms from CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, 30, OLD BURLINGTON STREET, LONDON, W.1, quoting No. 84595/56/8. Completed application forms should be returned by 23rd June, 1956. L 929

ATOMIC ENERGY RESEARCH ESTABLISHMENT,
HARWELL,
require a

TECHNICAL ASSISTANT

in the SPECIAL PLANT Section of the Engineering Services Division, to give engineering assistance in the installation, commissioning, modification and maintenance of electrical and mechanical equipment for major scientific projects. These duties will provide experience in a wide and unusual field.

Applicants should be not more than 32 years of age and should have served a recognised engineering apprenticeship and be graduate members of the Institution of Electrical Engineers, or have exempting qualifications such as a degree in Electrical Engineering.

SALARY : £535 (at age 21)-£925.

Very good prospects of promotion to Engineer III carrying a maximum salary of £1199.

Contributory Pension scheme; five-day week; excellent working conditions and generous leave allowances.

Married officers living outside the Establishment's transport area will be eligible for housing under Authority arrangements or, alternatively, substantial assistance towards legal expenses incurred in house purchase will be available.

Send POST CARD for application form, which must be returned by 18th June, 1956, to ESTABLISHMENT OFFICER, A.E.R.E., HARWELL, DIDCOT, BERKS., quoting reference 558/26. L 895

KUMASI COLLEGE OF TECHNOLOGY.
(Principal: W. E. DUNCANSON, Ph.D., D.Sc., F.Inst.P., A.M.I.E.E.)

Applications are invited for the following posts in the School of Engineering:—

HEAD OF DEPARTMENT OF CIVIL ENGINEERING.

PENSIONABLE SALARY SCALE: £1975 by 50 to £2225 plus a £250 per annum non-pensionable professional allowance plus a non-pensionable 5 per cent. addition to the pensionable salary pending revision of the Salary Scale.

SENIOR LECTURERS/LECTURERS IN (*a*) **CIVIL,** (*b*) **MECHANICAL,** (*c*) **ELECTRICAL ENGINEERING.**

PENSIONABLE SALARY SCALES:
Senior Lecturer: £1600 by 50 to £1850.
Lecturer, £1080 by 40 to £1560.

Appointments to all the above posts could be made on Contract if applicants so desired with a 25 per cent. increase in the pensionable salary offered plus a gratuity of £150 per annum at the end of the Contract, or arrangements to continue policies initiated under the F.S.S.U. scheme might be made.

QUALIFICATIONS:

Good Honours Degree in Engineering and preferably Corporate Membership of the relevant professional Engineering Body together with appropriate experience.

Free first class passages for person appointed, wife and up to three children under 17. Normally annual home leave.

Accommodation with basic furniture will be provided; rent according to consolidated salary.

Applications (6 copies) should be submitted to the APPOINTMENTS SECRETARY, THE ADVISORY COMMITTEE ON COLONIAL COLLEGES OF ARTS, SCIENCE AND TECHNOLOGY, 1, WOBURN SQUARE, LONDON, W.C.1, giving details of age, education, qualifications, experience and the names of 3 referees. Closing date 30th June. L 930

EXECUTIVE ENGINEERS—
NORTHERN RHODESIA.

Vacancies exist for

CIVIL ENGINEERS for building and road construction works.

Appointment on contract/gratuity terms with salary from £1245-£1895 plus gratuity £37 10s. for each 3 months satisfactory service; Free passages; Free medical attention; Generous leave.

Candidates should have either (*a*) University degree in Civil Engineering recognised by Institution of Civil Engineers and 2 years subsequent experience, or (*b*) passed Parts I and II Finals of the Institution of Civil Engineers examination and had a total of 5 years experience civil engineering works.

Apply DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give age, qualifications, experience. Quote BCD.112/3/07/D5. L 875

THE NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE invites applications for posts as **ENGINEERING ASSISTANTS.** The minimum qualification is either the National Certificate or Inter.B.Sc., in any branch of engineering or science, particularly in fuel technology. Industrial experience will be an advantage.

Vacancies exist in London and Cardiff, Manchester and Dundee provincial Area Offices. Salary band in London will be from £678 10s. p.a. (age 25) to £845 p.a. and elsewhere £663 10s. p.a. to £829 p.a.

N.I.F.E.S. Engineering Assistants are encouraged to make themselves eligible for promotion by obtaining the necessary qualifications.

Successful candidates will be required to serve a probationary period of not more than one year and will become Members of the Company's Superannuation Scheme after one year's service. Application forms may be obtained from the NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE, DEPT. E.A., 71, GROSVENOR STREET, LONDON, W.1. L 927

TECHNICAL COLLEGE,
GLASGOW.
(Affiliated to the University of Glasgow.)
DEPARTMENT
OF
ELECTRICAL ENGINEERING.

Applications are invited for

TWO LECTURESHIPS IN ELECTRICAL ENGINEERING. One is in the Electronics Section, and some previous experience in Servomechanisms is desirable. For the other, candidates should preferably have some experience or interest in High Voltage Engineering or Electrical Measurements.

The scale for lecturers is £650 by £50 to £1350, with an efficiency bar at £1100; F.S.S.U. superannuation and family allowances; starting salary depends on qualifications and experience. Application forms may be obtained from the SECRETARY. L 950

DURSLEY TECHNICAL INSTITUTE, maintained by the Gloucestershire Education Committee, requires in September

A TEACHER OF WORKSHOP ENGINEERING to at least City and Guilds Intermediate standard, and Workshop Technology to Ordinary National Certificate standard.—Apply for this Grade A post (no forms) to the PRINCIPAL, enclosing copies of two recent testimonials and the names and addresses of two referees. S.A.E. should be enclosed if testimonial are to be returned. L 908

SOMERSET EDUCATION COMMITTEE.

BRYMORE SCHOOL, CANNINGTON. This Secondary Technical School of Agriculture, a boarding school with some day boys, requires in September, 1956, an

ASSISTANT MASTER TO TEACH AGRICULTURAL ENGINEERING, especially the principles and practice of the construction and maintenance of farm machinery, together with Engineering Drawing. Some Metalwork would be an added advantage.

A practical man with a love of the country is sought. For a bachelor a flat is available and full board and lodging would be free in return for duties as Assistant House Master. Salary: Burnham Assistant's Scale.

Particulars and application forms returnable by 22nd June, 1956, can be obtained from the undersigned.

W. J. DEACON,
CHIEF EDUCATION OFFICER.

COUNTY EDUCATION OFFICE,
TRULL ROAD,
TAUNTON. L 882

MONMOUTHSHIRE EDUCATION COMMITTEE.

ABERTILLERY MINING AND TECHNICAL INSTITUTE.

Applications are invited from suitably qualified men for the following posts:—

(a) **FULL TIME TEACHER** with qualifications and experience in Mechanical Engineering Workshop Practice for classes of Colliery Engineering Apprentices and some classes in the Secondary Technical School.

(b) **FULL-TIME TEACHER** with qualifications and experience in Mechanical Engineering Workshop Practice mainly for classes of Mine Entrants.

QUALIFICATION FOR EACH POST: Graduate or Higher National Certificate in Mechanical Engineering or City and Guilds Final Certificate in Machine Shop Practice.

SALARY: Burnham Technical Scale Grade "A."

Further details and forms of application may be obtained from the under-signed to whom completed forms should be returned not later than Friday, 15th June, 1956.

C. E. GITTINS,
DIRECTOR OF EDUCATION.

COUNTY HALL,
NEWPORT, MON. L 911

RESEARCH ASSISTANT IN ENGINEERING.

QUEEN MARY COLLEGE
(University of London),
MILE END ROAD, E.1.

The College offers a research assistantship for the continuation of investigations into the problems of condensation of steam to a suitably qualified graduate wishing to work for a higher degree. Salary rate £400 to £600 p.a. according to qualifications and experience. For further information apply to the REGISTRAR (CMH). L 905

ENGINEER (MAIN GRADE)
required by the ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS., to be responsible for three teams engaged on:—

(1) Engineering of electronic equipment from the prototype to the production stage.
(2) Inspection and maintenance of electronic equipment.
(3) Design of small power transformers, chokes, coils, etc.

Applicants should have served a recognised engineering apprenticeship and possess A.M.I.E.E. or have exempting qualifications. An up-to-date knowledge of circuit theory and a wide experience of the various types of instruments used in the field of electronics and the methods used in their manufacture is essential. A good knowledge of the application of plastics is also desirable.

SALARY: £1199-£1504 p.a. Contributory Superannuation scheme. Married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates; alternatively assistance towards legal expenses incurred in house purchase may be available.

Requests for application forms by POSTCARD to the SENIOR RECRUITMENT OFFICER at the above address. Please quote ref. 1177/26. L 880

WATER ENGINEERS—
NORTHERN RHODESIA.

Vacancies exist for

WATER ENGINEERS to supervise the survey and to execute the design of irrigation and conservation works.

Appointment can be either (*a*) on probation for permanent and pensionable establishment with salary in scale £945-£1850, or (*b*) on Contract/gratuity terms in the salary range £1245-£1895. Starting salaries will be determined by length of experience above the minimum mentioned below. Free passages; Free medical treatment; Generous home leave.

Candidates who should be between 23 and 35 should hold a University degree or diploma recognised as exempting from or have passed Final Parts I and II of the A.M.I.C.E. examination. Not less than 2 years' practical civil engineering experience in the case of degree men or 5 years' in the case of candidates who have taken the I.C.E. examinations.

Apply DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give details of age, qualifications, experience. Quote BCD.140/3/01/D5. L 873

PORTSMOUTH COLLEGE OF TECHNOLOGY.

Applications are invited for the post of **ASSISTANT GRADE B** in the Electrical Engineering Department to teach Electrical Installation, Electrical Technician, and Ordinary National Certificate work. Duties to commence on 1st September, 1956. Salary: Burnham Grade "B" (£525-£820).

Application forms from the REGISTRAR, COLLEGE OF TECHNOLOGY, PARK ROAD, PORTSMOUTH, to whom they should be returned as soon as possible.

E. G. BARNARD,
CHIEF EDUCATION OFFICER. L 948

METROPOLITAN WATER BOARD

have the following vacancies on the

PERMANENT PENSIONABLE STAFF

ASSISTANT ENGINEERS

(Civil, Mechanical and Electrical.)
Salary scale: £856-£1054 per annum.
Applicants must be corporate members of the Institution of Civil Engineers, Mechanical Engineers or Electrical Engineers and must have had sound engineering experience. (Ref. EG1.)

ENGINEERING ASSISTANTS

(Civil, Mechanical and Electrical.)
Salary scale: £552-£823 per annum.
Applicants must be corporate members of one of the above mentioned Institutions or have passed or be exempted from passing Sections A and B (or Parts I and II) of the examination of the appropriate Institution. (Ref. EG2.)

SENIOR DRAUGHTSMEN

(Civil Engineering.)
Salary scale: £765-889 per annum.
Applicants must have had responsible experience in the design of civil engineering works and must possess a General School Certificate or have passed an equivalent examination. Ref. EG3.)

JUNIOR DRAUGHTSMEN & DRAUGHTSWOMEN

(Civil, Mechanical, Electrical, Architectural and Map and Plan.)
Salary scale: Age 16, £237; 17, £275; 18, £322; 19, £356; 20, £391; 21, £425; rising by annual increments to a maximum of £630 per annum at age approximately 29.
Applicants must possess a General Certificate of Education with passes in English, Mathematics and three other approved subjects, or a General School Certificate, or have passed an equivalent examination. (Ref. EG4.)

For some of the above-mentioned vacancies housing accommodation may be available at a reasonable rental.

Commencing salaries for all appointments will be according to age, qualifications and experience. Office hours: 9 a.m. to 4.30 p.m. (Mon., 5 p.m.); Saturday, 9 a.m. to 12 noon. Saturday morning leave according to service. Social and sports club facilities. Staff restaurant.

Forms of application may be obtained from the undersigned. The appropriate reference should be quoted.

S. D. ASKEW,
Clerk of the Board.

Offices of the Board, New River Head, Rosebery Avenue, E.C.1. L 906

CITY OF BIRMINGHAM PUBLIC WORKS DEPARTMENT.

Applications are invited for the following posts:

(*a*) **HEATING AND VENTILATING ENGINEERING ASSISTANTS, GRADE A.P.T. V** (£795/£970 per annum).

(*b*) **HEATING AND VENTILATING ENGINEERING ASSISTANT, GRADE A.P.T. IV** (£710/£885 per annum).

Commencing salary in accordance with qualifications and experience.

Applicants should be Associate Members of the Institution of Mechanical Engineers or of the Institution of Heating and Ventilating Engineers, or hold equivalent qualifications, and should have experience in the design, specification and supervision of contracts for heating, ventilating and allied services in large public buildings.

The posts are permanent, superannuable, subject to a medical examination and to one month's notice on either side.

Applications endorsed with the description of the post applied for, stating qualifications, age and experience, together with the names of two persons to whom reference can be made, should reach the undersigned not later than 30th June, 1956.

Canvassing disqualifies.

HERBERT J. MANZONI,
CITY ENGINEER AND SURVEYOR.

CIVIC CENTRE,
BIRMINGHAM, 1. L 904

COUNTY BOROUGH OF SMETHWICK EDUCATION COMMITTEE.

THE CHANCE TECHNICAL COLLEGE.
(Principal: F. W. COOPER, B.Sc., M.I.Mech.E., M.I.Prod.E.)

GRADE "A" ASSISTANT to commence in September, 1956, to teach City and Guilds Machine Shop Engineering subjects, Technical Drawing, Workshop Science, Calculations and Technique. Ability to assist with some Mechanical and Production Engineering subjects an advantage. Candidates should possess appropriate qualifications at least to the level of Higher National or Final City and Guilds Certificate, with adequate industrial experience.

Application forms may be obtained from the CHIEF EDUCATION OFFICER, 215, HIGH STREET, SMETHWICK, 41, STAFFS., and returned as soon as possible.

E. L. TWYCROSS,
TOWN CLERK. L 899

COUNTY BOROUGH OF SMETHWICK EDUCATION COMMITTEE.

SMETHWICK HALL SECONDARY MODERN SCHOOL FOR BOYS.
Head Master: Mr. F. KITSON, B.A.

METALWORK TEACHER required in September, to take charge of one of the metalwork shops. Applications should have either a Teachers Certificate or a Full Technological Certificate or a Higher National Certificate or City and Guilds Handicrafts Certificate.

Present salary scales are £450 to £725 with prospect of very greatly improved salary scales in October. Allowance for industrial and service experience in fixing commencing salary.

Application forms may be obtained from the CHIEF EDUCATION OFFICER, 215, HIGH STREET, SMETHWICK, STAFFS., and should be returned as soon as possible.

E. L. TWYCROSS,
TOWN CLERK. L 919

KENT COUNTY COUNCIL
requires

AREA MAINTENANCE ENGINEER with good practical experience in the design and maintenance of electrical and/or heating, hot and cold water and cooking installations in buildings. Salary within Scales £710-£885 or £640-£765 according to experience.—Application forms from COUNTY ARCHITECT, SPRINGFIELD, MAIDSTONE. Closing date 26th June, 1956. L 914

AUCKLAND UNIVERSITY COLLEGE.
(UNIVERSITY OF NEW ZEALAND.)

The College Council invites applications for the **CHAIR OF ENGINEERING (MECHANICAL).**

The salary for the Chair is £2150 per annum. An unfurnished house will be available at a moderate rental.

An allowance is made towards travelling expenses. The Professor appointed will be expected to take up his duties on a date to be arranged, preferably not later than the 1st February, 1957.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

The closing date for the receipt of applications, in New Zealand and London, is 31st July, 1956. L 913

AIR MINISTRY Works Designs Branch requires
(A) in LONDON.

(1) DESIGNER/DRAUGHTSMEN (Order No. 1005) for bulk petroleum storage and pumping installations experienced in one or more of the following:—

(*a*) Storage tank layout and design, (*b*) pump house and plant layout, (*c*) development of pipe line schemes, (*d*) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £761 p.a.

(2) STRUCTURAL ENGINEERING DESIGNER/DRAUGHTSMEN (Order No. 1001) for reinforced concrete or structural steel work with sound technical training and several years varied experience in design/detailing of:—

(*a*) Reinforced concrete construction for all types of buildings, or (*b*) steel framed sheds, warehouses and similar buildings, and

CIVIL ENGINEERING DESIGNER/DRAUGHTSMEN (Order No. 1002) experienced in one or more of the following branches of engineering:—

(*a*) Earthworks and Stormwater Drainage, (*b*) Foul Drainage and small disposal works, (*c*) Water Pumping Treatment and Distribution. Salaries up to £898 p.a.

(B) IN LONDON AND PROVINCES (with liability for overseas service)

ELECTRICAL ENGINEERING DRAUGHTSMEN (Order No. 1004) experience in preparation of schemes for illumination and electrical equipment of buildings or in electrical distribution H.V. and M.V. Technical training to O.N.C. standard or equivalent an advantage. Salaries up to £898 p.a. Starting pay dependent upon age quals. and experience. Paid overtime. Long term possibilities with pensionable and promotion prospects. Four weeks' leave a year. Normally natural born British subjects. Write, stating age, quals., employment details incl. type of work done to any Employment Exchange quoting Borough and relevant Order No. G 657

Just Published

ELECTRONIC MEASUREMENTS

AND

MEASURING INSTRUMENTS

by F. G. Spreadbury

Although the science of electronic instrumentation is relatively new, the number of different instruments and measuring techniques is already so numerous that it would be impossible to give an account of, or even reference to, all within a single volume. However, certain basic types of electronic instruments and measuring techniques may be readily distinguished, owing to their common use. To these the present work is mainly directed since a perusal of past and current electronic literature will show many instruments designed to meet special requirements. Because the stability of electronic instruments depends so largely on that of many of their components, considerable attention has been given to these and the problem of their stability. Valve characteristics relative to measurement are discussed together with the subject of stabilization by negative feedback. A number of basic-type instruments are fully described, many of these being of the author's design. The uses to which a particular instrument can be put cannot, of course, be completely stated. However, its potentialities are often implicit in its description and in many cases possible applications are given. Generally, the reader is assumed to possess a knowledge of basic electronics, but in some chapters principles are developed, particularly when they are appropriate to some piece of auxiliary apparatus.

Demy 8vo. Illustrated. 50*s.*

CONSTABLE & CO. LTD.
10 ORANGE STREET, LONDON, W.C.2

Classified Advertisements continued on Page 4

SURREY EDUCATION COMMITTEE.

REDHILL TECHNICAL COLLEGE,
REDSTONE HILL, REDHILL.

Applications are invited for a
TEACHER OF ENGINEERING SUBJECTS, especially Science and Mathematics in the Preliminary Technical, City of Guilds and Ordinary National Certificate courses. The post is offered as a Grade "A" Assistant but for a man of exceptional teaching ability and good qualifications it may be made a Grade "B" appointment.
Further particulars and form of application obtainable from the PRINCIPAL. L 957

CENTRAL ELECTRICITY AUTHORITY.

SOUTH EASTERN DIVISION.

1. MAINTENANCE ENGINEER
CROYDON "A" POWER STATION.
Applicants should preferably possess Higher National Certificate in Mechanical and/or Electrical Engineering or an equivalent qualification. Experience in the maintenance of H.P. turbine and boiler plant, electrical plant and all Power Station auxiliary plant is required. Class F, Grade 5, £892 10s. to £955 10s. p.a. including London Allowance.
2. THIRD ASSISTANT ENGINEER (OPERATION).
DIVISIONAL HEADQUARTERS BASED AT KINGSTON.
Required to make investigations and analyse all aspects of power station operation so that the operational effectiveness of plant, equipment, organisation, etc., may be determined and recommendations for improvement made. Candidates should have been educated to H.N.C. standard and preferably have power station experience. Class AX/DX. Grade 4, £850 10s.-£1060 p.a. including London Allowance.
3. ASSISTANT ENGINEER (EFFICIENCY).
BRIGHTON "A" AND "B" POWER STATIONS.
Applicants should preferably have had technical training up to H.N.C. standard and must have had experience in the operation of a modern power station, together with a knowledge of methods of plant efficiency control. Class 1, Grade 11, £850-£910 p.a.
4. GENERAL ASSISTANT ENGINEER (EFFICIENCY).
LITTLEBROOK POWER STATION.
To assist in the plant testing and the maintenance of efficiency reports. This post offers excellent opportunity for obtaining general Power Station experience. Class L, Grade 18, £588-£635 5s. p.a. including London Allowance.
5. ENGINEERING DRAUGHTSMAN.
BRIGHTON "A" AND "B" POWER STATIONS.
Applicants should preferably possess O.N.C. in Electrical or Mechanical Engineering and have had drawing office experience. A knowledge of Power Station design and layout an advantage. Schedule D, Grade 6, £560-£680 p.a.
N.J.B. Conditions of Service. Applications giving full details of education, present position, experience, etc., should be sent, according to the location of the vacancy to the following:—
1. Station Superintendent, Croydon "B" Power Station, Beddington Farm Road, Croydon, Surrey.
2. Establishments Officer, Central Electricity House, Lower Ham Road, Kingston-upon-Thames, Surrey.
3 and 5. Station Superintendent, Brighton "A" and "B" Power Stations, Portslade-by-Sea, Sussex.
4. Station Superintendent, Littlebrook Power Station, near Dartford, Kent.
CLOSING DATE 16th June. L 955

THE ELECTRICAL RESEARCH ASSOCIATION.
Applications are invited from
GRADUATES IN PHYSICS, ENGINEERING OR PHYSICAL CHEMISTRY for fundamental and applied research in various applications of Electricity. Starting salaries are from £550 to £700 for those without post-graduate qualifications or from £650 to £900 for those with higher qualifications. Appointments are eligible for superannuation under the F.S.S.U.
Applications should be made to the PERSONNEL OFFICER, ELECTRICAL RESEARCH ASSOCIATION, THORNCROFT MANOR, DORKING ROAD, LEATHERHEAD, SURREY. L 984

SURREY EDUCATION COMMITTEE.

KINGSTON TECHNICAL COLLEGE,
FASSETT ROAD, KINGSTON-ON-THAMES.

ENGINEERING DEPARTMENT.

Assistant Lecturer Grade B required in
PRODUCTION ENGINEERING, to commence September, 1956. Candidates should be Graduates or have appropriate professional qualification. Salary, £525 by £25 to £820 plus London Allowance, with additional allowances for Graduate qualifications, approved training and experience.
Particulars and application from Principal on receipt of S.A.E., to be returned within fortnight rom date of advertisement. L 961

OXFORDSHIRE EDUCATION COMMITTEE.

NORTH OXFORDSHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, BANBURY.
Principal: N. A. PRATT, A.T.D.

Applications invited for post of
ASSISTANT LECTURER GRADE "A" to teach electrical installation work up to Final City and Guilds course "B" and to assist with electrical science and mathematics in the national certificate course. Duties will include responsibility for the electrical laboratory. Industrial and teaching experience or training is desirable.
Application forms are obtainable from THE REGISTRAR, NORTH OXFORDSHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, 51, THE GREEN, BANBURY, should and be returned within ten days of the appearance of this advertisement.
A. R. CHORLTON, M.A.,
DIRECTOR OF EDUCATION.
COUNTY OFFICES,
OXFORD. L 962

PRESTON.

HARRIS COLLEGE OF FURTHER EDUCATION.

Applications are invited for the post of
ASSISTANT LECTURER, GRADE B, in the Mechanical Engineering Department.
Candidates should possess a Degree or equivalent qualification and should have had good practical experience.
Forms of application can be obtained from the undersigned to whom they should be returned within 14 days of the appearance of this advertisement.
H. WILKINSON, Ph.D., M.Sc., A.Inst.P.,
PRINCIPAL.
HARRIS COLLEGE,
CORPORATION STREET,
PRESTON, LANCS. L 982

STAFFORDSHIRE COUNTY COUNCIL EDUCATION COMMITTEE.

COUNTY TECHNICAL COLLEGE,
STAFFORD.
Principal: A. TORKINGTON, B.Sc. (Hons.), M.I.Mech.E., A.M.I.P.E.

Applications are invited for the following appointments to commence on 1st September, 1956, or as soon as possible thereafter.
(1) **LECTURER TO TEACH MECHANICAL ENGINEERING** subjects to Higher National Certificate and Degree standard. Applicants should possess a University degree and have industrial or research experience and teaching experience.
(2) **ASSISTANT, GRADE B, TO TEACH MECHANICAL ENGINEERING** subjects to National Certificate and Diploma students. Applicants should have suitable qualifications together with industrial and teaching experience.
(3) **ASSISTANT, GRADE B, TO TEACH PHYSICS** up to G.C.E. "A" level and Chemistry up to "O" level, or vice versa, together with some elementary mathematics. Applicants should have a University degree.
Salaries for the above posts are according to the Burnham Scales for Technical Teachers which are under review. The present salaries applicable to the above posts are, Lecturer: £965 by £25 to £1065; Grade B, £525 by £25 to £820 with allowances for degree, training and experience.
Forms of application and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope. Applicants are requested to state for which post forms are required. Completed forms must be returned by 23rd June, 1956.
J. H. P. OXSPRING,
DIRECTOR OF EDUCATION.
DEPT. F.E.,
COUNTY EDUCATION OFFICE,
STAFFORD. L 983

BURNLEY EDUCATION COMMITTEE.

MUNICIPAL COLLEGE.

ASSISTANT LECTURER (GRADE "B") required from 1st September, 1956, to teach Mechanical Engineering subjects up to London Degree standard in Engineering. Applicants must have recognised technical qualifications plus industrial experience. Increments allowed for approved teaching and industrial experience.
Application forms from the DIRECTOR OF EDUCATION, 111, Manchester Road, Burnley, to be returned completed within ten days from today.
C. V. THORNLEY,
TOWN CLERK. L 972

GOVERNMENT OF CEYLON.

CEYLON HYDRO-ELECTRIC SCHEME—STAGE IIA.
Applications are invited for the appointment of an **ELECTRICAL AND MECHANICAL RESIDENT ENGINEER** for a period of 24 months for the supervision of a contract in connection with the above scheme. The contract provides for two horizontal shaft 11 kV alternators of 12.5 mW driven by pelton turbines, 132 kV, 66 kV and 33 kV S.O.V. switchgear.
Salary offered is £2500 per annum paid at the advantageous rate of Rs. 15 to £1. The Ceylon Government will contribute 7½ per cent. of salary to a Provident Fund. Free passages will be provided for the successful applicant. Temporary housing will be provided at a rental of approximately Rs. 50 per mensem economic rent. Furniture and effects will be provided at annual rentals of 5 per cent. on basic furniture and 10 per cent. on non basic furniture.
Applicants must be Corporate Members of the Institution of Electrical Engineers and have had experience in the construction or supervision of the erection of water turbine driven alternator sets preferably overseas. The successful applicant will be required to spend some time in France at the works of the Contractors before proceeding to Ceylon.
Applications giving full details of experience should be submitted in triplicate to PREECE, CARDEW & RIDER, 8, 10 and 12, QUEEN ANNE'S GATE, WESTMINSTER, LONDON, S.W.1. L 881

UNIVERSITY COLLEGE OF SWANSEA.
Applications are invited for EITHER an **ASSISTANT LECTURESHIP** OR A **LECTURESHIP IN ELECTRICAL ENGINEERING.** It is desirable but NOT essential that candidates' interest be in one of the fields: transistor circuitry; control systems, which can be large power speed control apparatus; or aerials.
Salaries:
Assistant Lectureship, not less than £550 per annum.
Lectureship, £650 by £50 to £1350 per annum.
Commencing salary in each case will be at a point on the appropriate scale according to age, qualifications and experience. Membership of the F.S.S.U. and children's allowance scheme.
Further particulars may be obtained from THE REGISTRAR, UNIVERSITY COLLEGE, SINGLETON PARK, SWANSEA, to whom applications (six copies) must be sent by JULY 16, 1956. L 979

LOUGHBOROUGH COLLEGE OF TECHNOLOGY.
Principal: H. L. HASLEGRAVE, Wh.Sc., M.A.(Cantab.), Ph.D.(London), M.Sc.(Eng.), M.I.Mech.E., M.I.E.E., M.I.Prod.E.
Applications are invited for the following posts:—
(a) **SENIOR LECTURERS IN MANAGEMENT SUBJECTS.**
(b) **LECTURER IN MANAGEMENT SUBJECTS.**
Two Senior Lecturers and one Lecturer are required, each to specialise in a branch of Management studies, one branch being Work Study. Applicants should have had considerable industrial and commercial experience, have held an executive post and preferably, possess a degree or professional qualification.
(c) **LECTURER IN MECHANICAL ENGINEERING.**
Applicants should hold a good Honours degree in Engineering of a British University, should have had industrial experience and be a corporate Member of the Institution of Mechanical Engineers. Previous teaching experience is desirable.
Salaries will be paid according to the appropriate scales in the Burnham Technical Report, 1954, namely:—
Senior Lecturers, £1065 by £25 to £1215.
Lecturers, £965 by £25 to £1065.
Further particulars and application forms may be obtained from the Registrar to whom completed forms should be returned as soon as possible. L 980

THE UNIVERSITY OF MANCHESTER.

Applications are invited from graduates in Physics, Chemistry, Metallurgy, Biology or Engineering for the post of
ASSISTANT LECTURER IN DENTAL MATERIALS. The person appointed will be concerned with work on the physical properties of dental materials. There is a wide scope for research in this field and ample facilities are available. Salary on a scale £550 by £50 to £650 per annum with membership of F.S.S.U. and Children's Allowance Scheme.—Applications should be sent not later than June 30th, 1956, to the REGISTRAR, THE UNIVERSITY, MANCHESTER, 13, from whom further particulars and forms of application may be obtained. L 709

CHIEF INSTRUCTOR (ELECTRICAL) required by N.C.B.'s Mines Mechanisation Training Centre, West Bar, Sheffield, to take charge of section which trains apprentice and colliery electricians and Directed Practical Trainees. Sound knowledge of Elec. Eng. and modern colliery electrical plants required, with teaching experience and H.N.C. Appointment (superannuable) within range £725 to £850, according to qualifications and experience.
Write, with full particulars of age, education, qualifications and experience to NATIONAL COAL BOARD, STAFF DEPT., HOBART HOUSE, LONDON, S.W.1, marking envelpe SS/296, before 22nd June, 1956. L 885

ROYAL TECHNICAL COLLEGE, SALFORD.
Acting Principal: J. F. YATES, B.Sc. (Lond.), MSc. (Belfast), M.I.E.E.

APPOINTMENT OF HEAD OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

The Governors invite applications for the post of **HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT,** duties to commence as soon as possible. The post is recognised as a Grade V Department under the 1954 Burnham Committee Report (Technical); the salary is £1515 by annual increments of £25 to £1665, but may be subject to upward revision under the forthcoming new Burnham Report.
Candidates should preferably have teaching, industrial and/or research experience, and be capable of taking charge of a large and growing department in a period of transfer to new extensions now being built. They should also be able to direct the growing volume of post-graduate courses and to develop research in the department.
Forms of application, together with further particulars of the post, may be obtained from THE PRINCIPAL, ROYAL TECHNICAL COLLEGE, SALFORD, 5, to whom they should be returned as soon as possible.
R. RIBBLESDALE THORNTON,
CLERK TO THE GOVERNORS. L 944

LONDON TRANSPORT require
ENGINEERING ASSISTANTS for Plant Engineer's Section, Chiswick Works. Applicants should possess practical knowledge of electrical equipment and installation work both lighting and power and should be able to prepare drawings, specifications and detailed estimates. Experience in control of staff advantageous.
Salary range, £750-£840. Medical examinations five-day week; contributory superannuation scheme after probation; free travel.—Applications within 14 days to RECRUITMENT AND TRAINING OFFICER (W/EV.586), LONDON TRANSPORT, 55, BROADWAY, S.W.1. L 895

GOVERNMENT OF KUWAIT.
ASSISTANT SHIFT CHARGE ENGINEERS, age 27-38, required for Steam Power Station and Water Distillation Plant. Service with the Government of Kuwait, Persian Gulf, to work under Shift Charge Engineer for period of one year, becoming Engineers in charge of shift if satisfactory. Commencing salary £1650 rising £100 p.a. to £1850. Previous shift operating employment with boiler and turbo-alternator plant and control room experience essential. No income tax, free furnished quarters and medical attention provided. Car allowance. Leave at rate of two months per annum, free air travel.
Applicants in the first place stating qualifications, training and experience to be addressed to PERSONNEL OFFICER, EWBANK & PARTNERS, LTD., ENGINEERING CONSULTANTS, 10-11, GROSVENOR PLACE, LONDON, S.W.1. L 887

McGRAW-HILL *Two important forthcoming titles*

ELECTRIC ANALOG COMPUTERS

SECOND EDITION

GRANINO A. KORN and T. M. KORN

A practical and comprehensive treatment of D-C analogues computers, used as differential analyzers, equation solvers, simulators and control system components. It shows how to set up problems for analogue computation, giving examples of practical applications in applied mathematics and engineering design. Methods for designing analogue computers, covering circuit theory, components, and complete systems are also described. Thus the book combines advice on tested methods of applying D-C analogue computers as computing aids and simulators with detailed information for the development of computer systems.

9 x 6 inches 425 pages Illustrated *Approx.* 67s. 6d.

RELIABILITY FACTORS FOR GROUND ELECTRONIC EQUIPMENT

Editor-in-Chief : KEITH HENNEY

Assisted by : IRVING LOPATIN, Associate Editor, and others

The first public document, on the lack of reliability of military electronic equipment. It assembles the statistics of unreliability, the reasons for the present poor reliability, and many techniques for improving reliability in the future. Useful fundamentals of statistical methods, electrical and mechanical engineering principles the human engineering side of the problem, broad principles governing the selection and use of component parts, and comments and data on such matters as training and service manuals, and maintenance and their influence on reliability are authoritatively covered by manufacturers and users of military electronic equipment.

8½ x 11 inches 233 pages Illustrated *Approx.* 56s. 6d.

To be published shortly by McGraw-Hill

NORTHAMPTON POLYTECHNIC, LONDON, E.C.1.

The Governing Body invites applications for the post of

PRINCIPAL, to be taken up on 1st January, 1957. Candidates should be qualified to direct a major technical college concerned with full-time and part-time education in relation to engineering to degree standard and other technologies, including post-graduate studies and research.

The Polytechnic is recognised for the Internal degree of B.Sc. (Engineering) London. It is an aided institution which is expected to play an important part in the development of Higher Technological education. The post also involves directing the work of the National College of Horology and Instrument Technology.

Salary scale under the current Burnham Report: £1915 by £75 to £2215 plus London Allowance.

Applications should be submitted by 6th JULY, 1956.

Further particulars and application form may be obtained from T. H. HOLMES, CLERK TO THE GOVERNING BODY. L 977

CARMARTHENSHIRE EDUCATION COMMITTEE.

AMMANFORD TECHNICAL COLLEGE.

Applications are invited for the following vacancies at the above named College:—

(1) **FULL-TIME ASSISTANT MASTER FOR WORKSHOP PRACTICE CLASSES** in Machine Shop Engineering and Bench Fitting with some Sheet Metal Work. Applicants should possess good workshop training and be holders of a National Certificate in Mechanical or Production Engineering or a City and Guilds qualification in Machine Shop Engineering. Mining experience is desirable. Salary in accordance with the Burnham Further Education Report, 1954, for Grade A Assistants.

(2) **FULL-TIME ASSISTANT MASTER FOR ENGINEERING SUBJECTS (MECHANICAL AND ELECTRICAL.** Applicants should be graduates in Engineering or hold equivalent qualifications with suitable industrial and/or teaching experience. Salary in accordance with the Burnham Further Education Report, 1954, for Grade B Assistants.

Duties to commence on 1st September, 1956.

Forms of application, which must be returned within two weeks of the appearance of this advertisement, may be obtained from the undersigned on receipt of a stamped addressed envelope.

IORWERTH HOWELLS, DIRECTOR OF EDUCATION.

COUNTY EDUCATION OFFICES, COUNTY HALL, CARMARTHEN. L 943

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE.

Applications are invited for the following posts:—

(a) **LECTURER IN MECHANICAL ENGINEERING.** Candidates should hold a degree in Mechanical Engineering, have practical experience in industry and in teaching and be able to teach the subject Machine Tools and Metrology to Higher National Certificate standard. Salary in accordance with the Burnham Technical Scale for Assistants Grade "B" (£525 by £25 to £820).

(b) **LECTURER IN ELECTRICAL ENGINEERING.** Candidates should hold a degree in Electrical Engineering. Ability to offer the subjects Electrical Measurements, Electronics and/or Telecommunications will be an advantage. Salary in accordance with Burnham Technical Scale for Lecturers (£965 by £25 to £1065).

The duties of both posts will commence on 1st September, 1956.

Further particulars and application form will be sent by the undersigned. Applications should be sent in to reach the undersigned not later than Monday, 25th June, 1956.

E. C. SMITH, PRINCIPAL. L 942

APPOINTMENTS OPEN.

AMENDED ADVERTISEMENT.

£3000 PER ANNUM or more is offered for a **DEPUTY DIRECTOR OF RESEARCH** for BRITISH WELDING RESEARCH ASSOCIATION. Applicant must have a good Honours degree in metallurgy, and be prepared to live in the Cambridge area. Apply :—DIRECTOR OF RESEARCH, B.W.R.A., 29, PARK CRESCENT, LONDON, W.1 L 769

STEELWORK DESIGNER required for the mathematical analysis of large indeterminate steel-frame structures and other calculation work in connection with electric power stations.—Apply by letter in the first instance, quoting reference SAR, to MIREZ AND MCLELLAN, CARLIOL HOUSE, NEWCASTLE-UPON-TYNE 1. L 788

DEVELOPMENT ENGINEERS AND PHYSICISTS

are required for work in the new and rapidly expanding laboratories of Louis Newmark, Ltd., at New Addington, Surrey. The work includes the design and development of instruments, and some working experience of small electromagnetic instruments is desirable. Good salary based on age and experience. Pension Scheme.—Apply in writing giving full particulars to: PERSONNEL OFFICER, LOUIS NEWMARK, LTD., PREFECT WORKS, PURLEY WAY, CROYDON. L 932

METALS ICI DIVISION

If having completed your National Service you are graduating this year in either Engineering or Physics, or if you already possess these or similar qualifications, you may be interested in the following opportunities in our RESEARCH DEPARTMENT at Birmingham, offering the most up-to-date facilities available for studying the problems of the non-ferrous metals industry.

MECHANICAL ENGINEERS

are required to undertake fundamental and practical research work in the rolling, drawing and extrusion of copper, aluminium, titanium and associated alloys. Suitable small scale research plant is available but investigators will be given ample opportunity to study the performance of existing production plant and to apply the results of their researches to such plant.

PHYSICISTS

are required to devise, design and apply apparatus for the measurement of properties of non-ferrous metals and alloys. This work calls for inventiveness and initiative in the practical application of classical physics to a variety of research problems.

Candidates should preferably, but not necessarily, be under 30 years of age. Whilst relevant experience would be advantageous it is not essential.

These positions offer generous starting salaries, dependent upon age, qualifications and experience, and there is adequate scope for progressive remuneration. The Company operates both Pension and Profit Sharing Schemes, and after joining the staff married men may receive a reasonable refund of removal (including travel) expenses, together with loans in approved cases, to assist them in house purchase.

Application forms or further information may be obtained from :

STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting RES/22/ENG. L 945

CHAPMAN & HALL

Now Available

AUTOMATIC PROCESS CONTROL
FOR CHEMICAL ENGINEERS

by

Norman H. Ceaglske

(Professor of Chemical Engineering, University of Minnesota)

Size: 9¼" × 6" 242 *pages* *Illustrated* 54*s net*

This is possibly one of the first books to present and apply the basic mathematical principles of process control in an elementary form. It is written directly for the chemical engineer—on the theory that chemical engineers cannot have a fully rounded knowledge of their profession unless they are familiar with the fundamentals of automatic control. In addition to a review of principles and their application to simple control systems, the author also includes methods for calculating the dynamic response of processes.

AIRCRAFT GAS TURBINES

by

C. W. Smith

(Aircraft Gas Turbine Division, General Electric Co., U.S.A.)

Size: 9¼" × 6" 464 *pages* *Illustrated* 70*s. net*

This work presents a complete picture of the gas turbine power plant. With the emphasis on basic theory, it offers an authoritative source of information on the design of the components, the calculation, analysis and prediction of performance, the correction of test results, and the presentation of performance data. Much of the material applies to stationary as well as to aircraft power plants.

FLUID FLOW IN PRACTICE

Edited by

J. R. Caddell

(E. I. du Pont de Nemours & Co., Wilmington, U.S.A.)

Size: 7½" × 5½" 127 *pages* *Illustrated* 24*s. net*

A collection of papers originally presented at the third 'Experience in Industry' Symposium sponsored jointly by the Philadelphia-Wilmington Section of the American Institute of Chemical Engineers and the University of Pennsylvania. Because of the wide scope of the fluid flow field, the material of this book was purposely restricted to the flow of liquids, including slurries, in pipelines and pumps, and to simple applications for gases. Industrial, chemical, mechanical and civil engineers will find much of interest in the volume.

37 ESSEX STREET, LONDON, W.C.2

ATOMIC ENERGY

H. M. HOBSON LTD.,

require the services of a first grade

ELECTRO-MECHANICAL DESIGNER

to take charge of the Design Office in their rapidly expanding

NUCLEAR ENGINEERING DIVISION

dealing mainly with control and ancillary equipment for Nuclear Reactors.

Preferably applicants should have an engineering degree or equivalent combined with a broad background of engineering design.

This is an Executive Staff appointment carrying an attractive salary. A pension scheme is in operation.

Write giving full particulars to

H. M. HOBSON LTD.,
FORDHOUSES,
WOLVERHAMPTON,
STAFFS. L 778

STRUCTURAL ENGINEER

required

with experience in prestressed concrete, to take charge of small drawing office and assist in development work.

Salary £1000 to £1250 according to experience.

Applicants should send details of qualifications and experience to :—

UDALLS, WEST QUAY ROAD, SOUTHAMPTON. L 936

ASSISTANT WORKS ENGINEER required by RICHARDSONS WESTGARTH (HARTLEPOOL) LIMITED. Applicants should have a good working knowledge of Machine Tools and will be responsible for the repair and maintenance of all such equipment in the Hartlepool Works. With a view to later extension of responsibility to include maintenance of buildings, electrical equipment and all services throughout the Factory, experience of such work would be an advantage.

Applications should be sent to the Group's Head Office, addressed to:—

THE MANAGING DIRECTOR, RICHARDSONS WESTGARTH & CO., LTD. (P.O. BOX No. 2), WALLSEND, NORTHUMBERLAND.

and marked "Appointment; Strictly Confidential." They will not be disclosed without consent.

L 813

F. PERKINS LIMITED require a **QUALIFIED ENGINEER,** for extended tours in Europe. Experience of Installation Problems of diesel engines (or I.C. engines) as power units for Vehicle, Agricultural, Industrial and Marine applications required. Engine sales experience and fluent knowledge of technical German are essential qualifications, other languages an asset. This is a senior appointment with good prospects.—Apply with full particulars to F. PERKINS LIMITED, EXPORT SALES DEPARTMENT, PETERSCOURT, PETERBOROUGH. L 801

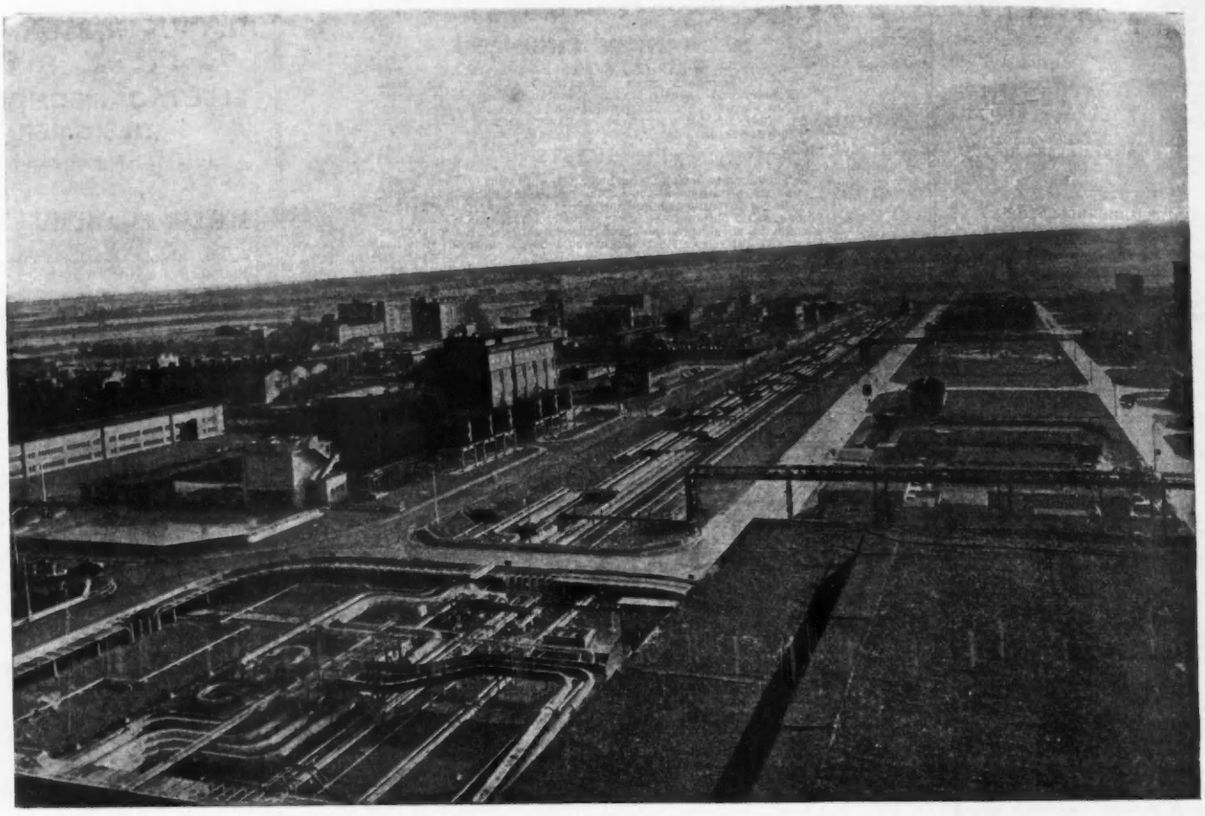
MANAGEMENT AND INDUSTRIAL CONSULTANTS

engaged in all types of Production, Organisation, Administrative and Costing functions are open to **ENGAGE ADDITIONAL STAFF.** Applicants must possess highest technical and professional qualifications in Engineering or Accountancy and should have practical managerial experience. Age not over 40. Remuneration on a high scale with superannuation and expense allowances.—Full details of qualifications and experience to BOX L 737, Offices of ENGINEERING.

A WELL KNOWN FIRM making Mechanical Presses and Special Machines, including "Automation" Equipment, has **VACANCIES IN ITS DESIGN OFFICE.** Interesting and creative work with opportunities for independent constructive thinking. Young men in course of training would be considered.—Apply stating experience, etc., to BOX L 752, Offices of ENGINEERING.

Classified Advertisements continued on Page 6

YOUR ROAD TO SUCCESS



Central Avenue, Wilton Works, Yorkshire

If you are aged 30 or under, have completed National Service, possess an Honours Degree and are either a Mechanical, Electrical or Instrument Engineer, then a post may await you at WILTON WORKS, working either on design and layout, construction, plant operation or maintenance.

Starting salaries are good.

WILTON WORKS is the largest post-war project of the British Chemical Industry. Since 1946 over £50 millions have been spent and development of the 2,000 acre site, which lies outside the industrial smoke belt, is being continuously expanded at the rate of over £1m. a month.

As befits this most modern of factories, working conditions are first class. So, too, are the recreational facilities — WILTON WORKS even possesses its own nine-hole golf course!

For a well-paid career, a job worth doing and a fine opportunity of rapid advancement, write TO-DAY to: Staff Manager, Imperial Chemical Industries Limited, Wilton Works, Middlesbrough, Yorkshire, quoting advertisement reference. IC1/X/310A.

WILTON ICI WORKS

THERE ARE OPENINGS **NOW** FOR
MECHANICAL ENGINEERS
ELECTRICAL ENGINEERS
INSTRUMENT ENGINEERS

IMPERIAL CHEMICAL INDUSTRIES LIMITED

L 798

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
ARMAMENTS DIVISION.

SENIOR ELECTRONIC AND ELECTRICAL ENGINEERS.

A number of Senior Engineers both Electronic and Electrical are required for work associated with the flight trials of guided weapons.

The work is of a very varied and interesting character, and includes system testing and the analysis of the behaviour of complex installations including mechanical and hydraulic components, in addition to electronic and electrical components.

A number of years' experience in electronic and/or electrical engineering is essential for these positions, and service experience of radar, radio and telecommunications is a very suitable qualification.

A university degree is not essential for these positions but practical experience and experience of experimental work is highly desirable.

The positions are responsible posts and carry attractive salaries and excellent prospects.

Pleasant working conditions and amenities are provided and an attractive superannuation scheme is in operation.

All replies should be addressed to:—
TECHNICAL APPOINTMENTS OFFICER,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.,
BAGINTON, NR. COVENTRY.
quoting reference FT/10/ARM/TAO. L 894

JIG AND TOOL DRAUGHTSMEN

required by a medium/large modern engineering works engaged in the machining and assembling of Automobile Components. Applicants must have served an apprenticeship and have obtained the Ordinary National Certificate. Good salary and conditions; Pension Scheme; Sports Club and opportunities for advancement.

Rented housing accommodation available in the New Town for successful applicants.

Write in the first instance to

LABOUR MANAGER,
ALFORD & ALDER (ENGINEERS) LTD.,
MAYLANDS AVENUE, HEMEL HEMPSTEAD, HERTS. L 829

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential, applicants with general mechanical engineering experience will be favourably considered. The posts offer excellent opportunities with generous salaries commensurate with experience and ability. Offices situated in the N.W.1 London area. Five-day week and superannuation scheme. Applications, which will be treated in confidence, should give previous experience and qualifications, and be addressed to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 664

STRUCTURAL ENGINEER with wide experience of the design and detailing of all types of steel structures and with administrative experience required to act as deputy to the Chief Engineer by large firm of London Consultants. The firm is expanding and the vacancy offers excellent opportunities for the right type of man.—Write in confidence giving details of previous experience and salary required to BOX No. 355, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 635

ELECTRICAL ENGINEERS who have completed their Military Service, and have some practical knowledge of design of any type of rotating electrical machinery, who would like to obtain experience in the design and manufacture of large high-speed Turbo-Generators, are invited to apply for a position which provides scope for development and the opportunity to take part in interesting work.

Apply, giving particulars of age and experience, to :—
CHIEF ENGINEER,
TURBO-GENERATOR ENGINEERING DEPARTMENT,
METROPOLITAN-VICKERS ELECTRICAL CO., LTD.,
TRAFFORD PARK, MANCHESTER, 17. L 771

JUNIOR DRAUGHTSMEN, having completed National Service, required for work on large chemical plant installations, A.E.S.D. minimum rates or above. Five-day week and superannuation scheme.—Apply by letter giving details of technical education to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 665

YOUNG ENGINEER, with works experience and keen on commercial side, wanted for Head Office Sales Dept. Pension Scheme.—Apply in confidence, stating age, qualifications and full particulars employment to date, MANAGING DIRECTOR, MEGATOR PUMPS & COMPRESSORS LTD., 43, BERKELEY SQUARE, LONDON, W.1. L 964

DRAUGHTSMEN, SENIOR, urgently required by firm of Consulting Engineers. Heavy structural steelwork and platework. High salary and bonus. Comfortable working conditions and subsidised meals. Five-day week. London area.—Write stating age, experience, and salary required to BOX L 963, Offices of ENGINEERING.

ENGINEERS AND ASSISTANT ENGINEERS, preferably qualified and having had site experience required for design work in London Office of Substantial firm of Civil Engineering Contractors near Victoria. Salary commensurate with ability, benefit of Superannuation Scheme.—Apply with full details to BOX L 960, Offices of ENGINEERING.

ROLLING STOCK DRAUGHTSMAN required, experienced in the design of various types of railway vehicles. Pension Scheme.—Apply stating age, experience and salary required to R. Y. PICKERING & CO., LTD., WISHAW, LANARKSHIRE, SCOTLAND. L 967

A. REYROLLE & CO., LTD., OF HEBBURN-CO. DURHAM, who are the largest firm of switch, gear specialists in the world, have vacancies for **CONTRACTS ENGINEERS,** both for home and overseas contracts work on E.H.V. and H.V. switchgear. The appointment would be for work at Hebburn, and it is customary for the Company to appoint engineers for duties in the overseas and home area offices from engineers trained at Hebburn. The work requires initiative and affords the engineer individual responsibility. It is interesting and varied and calls for ability to conduct both technical and commercial negotiations. The desirable qualifications are therefore a Degree or a Higher National Diploma or Higher National Certificate, but candidates having an Ordinary National Certificate who are still proceeding with studies could be considered specially. Applicants need not have specialised previously in switchgear, and, if necessary, suitable introductory training would be arranged. Applications, giving full particulars of technical training and previous experience, should be forwarded to the CONTRACTS MANAGER, A. REYROLLE AND CO., LTD., HEBBURN, CO. DURHAM, marked "PERSONAL." L 892

MECHANICAL ENGINEERING DRAUGHTSMEN
and
CIVIL ENGINEERING DRAUGHTSMEN

IMPERIAL CHEMICAL INDUSTRIES LIMITED BILLINGHAM DIVISION

offer attractive salaries in respect of several vacancies for each of the above classes of draughtsmen. Candidates must possess as a minimum qualification, the appropriate Higher National Certificate or its equivalent. Participation in Staff Pension Fund and Profit-Sharing Scheme. Financial assistance towards removal expenses available for married men. Without commitment, write for Application Form to the STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, BILLINGHAM DIVISION, BILLINGHAM, CO. DURHAM, quoting reference R.17. G 666

WILTON (ICI) WORKS

ENGINEERING DESIGNERS

The construction of the Company's factory at Wilton on a 2000-acre site has proceeded continuously since 1946 and now over ten million pounds are spent each year on new works. Staff with experience in design of modern works are required for this development.

The immediate vacancies are in the Design Office for :—

ASSISTANT TECHNICAL OFFICERS
MECHANICAL ELECTRICAL
CIVIL STRUCTURAL
INSTRUMENT

The appointments are to permanent staff and the Company is anxious to engage men who have had first rate experience to assist with the long-term plans for further development. Candidates in this category will be invited to interview, without commitment, at the Company's expense.

SALARIES
Commencing salaries up to £900 per annum will depend on the age and experience of candidates. The salaries of men engaged will be reviewed annually.

TERMS OF EMPLOYMENT
Five-day, 39-hour working week, Pension Fund, Profit Sharing Scheme, etc.

HOUSING
After joining the staff married men will receive a reasonable refund of removal (including travel) expenses, and to assist them in house purchase, facilities are available in approved cases for substantial loans; in addition, legal charges will be advanced.

Assistance is given in the procuring of rented houses, flats or lodgings.

Wilton is situated at the foot of the Cleveland Hills in Yorkshire, five miles from the coast. Working conditions are good and recreation facilities, including golf, tennis and badminton, are available.

Write for application form to: Staff Manager, Imperial Chemical Industries Limited, Wilton Works, Middlesbrough, Yorkshire, quoting advertisement reference ICI/X/302/e. L 541

SIMMONDS AEROCESSORIES LTD., TREFOREST INDUSTRIAL ESTATE, GLAMORGAN, have the following vacancies in their Drawing Offices :—

ELECTRICAL: ONE ELECTRICAL DESIGN DRAUGHTSMAN with some experience of small electro-mechanical components.
One Junior (21-23 years) for Detail Work.

MECHANICAL: ONE DESIGN DRAUGHTSMAN for Filtration equipment—knowledge of Pressure Vessels would be an advantage.
One Design Draughtsman for Mechanical Tank Contents Gauges.
One Drawing Office Checker—must be an experienced Draughtsman—knowledge of patent specifications an advantage.
One Junior (21-23 years) for Detail Work.

The above appointments are all progressive carrying salaries commensurate with the work undertaken. Five-day week and Pension Scheme are in operation.

Applicants are asked to send full details of age, training and experience to the PERSONNEL MANAGER. L 824

AERO ENGINE CONTROL SYSTEM.

ENGINEERS are required for a newly formed department dealing with various theoretical aspects of aero engine control problems. Experience of servo mechanism analysis and gas turbine engine performance investigation is desirable.—Applications quoting END to TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 658

EXPERIENCED PLANNING ENGINEERS required for production methods on medium I.C. engine components and fuel injection equipment. Pleasant working conditions, generous salary. Attractive Pension Scheme and Comprehensive Welfare Facilities.
Apply CHIEF PERSONNEL OFFICER, PETTERS LIMITED, CAUSEWAY WORKS, STAINES, MIDDX. G 662A

G.E.C. STANMORE LABORATORIES
require a
CHIEF INSPECTOR

for the Engineering Development Group for work on Guided Weapon and Radar Projects.

Applicants should have had responsible experience of inspection in the Electronics industry both on the production line and at the stage of final test, and be well versed in A.I.D. procedure. A good knowledge of precision mechanical and electrical equipment, including microwave components, is essential. Familiarity with metallurgical, metal finishing and resin casting processes would be of particular advantage. Apply in writing, giving full details of education, qualifications and experience to the

STAFF MANAGER, THE GROVE, STANMORE COMMON, MIDDLESEX, QUOTING REF. E/JEM. L 756

DESIGN DRAUGHTSMAN required for design of equipment and instruments for a very comprehensive range of experiments in the research laboratories of British Insulated Callender's Cables, Limited, 38, Wood Lane, W.12. Candidates should be of Higher National Certificate or equivalent standard and should have had workshop training. Previous experience in this class of work would be desirable but it is not essential and good general mechanical experience would be acceptable. Candidates should be in the age range 25/30. The position would lead to permanency and is pensionable after a qualifying probationary period.—Write giving details of age, qualifications and experience to STAFF OFFICER, B.I.C.C. LIMITED, 21, BLOOMSBURY STREET, LONDON, W.C.1, reference L/28/56. L 939

CONSULTING ENGINEERS require
CIVIL ENGINEERING INSPECTOR OF WORKS for factory construction in Wandsworth. Age under 35 preferred.—Apply SIR BRUCE, WHITE, WOLFE BARRY & PARTNERS, 1, LYGON PLACE, S.W.1. 'Phone: SLOane 0431. L 954

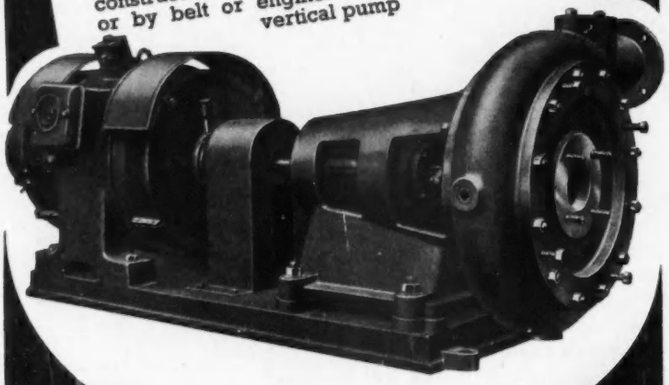
ELECTRICAL ENGINEER AS ASSISTANT TO CHIEF ENGINEER for development work now in progress on Steel Plant, etc., and on future schemes. State age, experience and technical qualifications and salary expected. Contributory Pension Fund and Welfare facilities. Good prospects.—Replies to SECRETARY, THE BRITON FERRY STEEL CO., LTD., BRITON FERRY, NEATH, GLAM. L 949

Classified Advertisements continued on Page 106

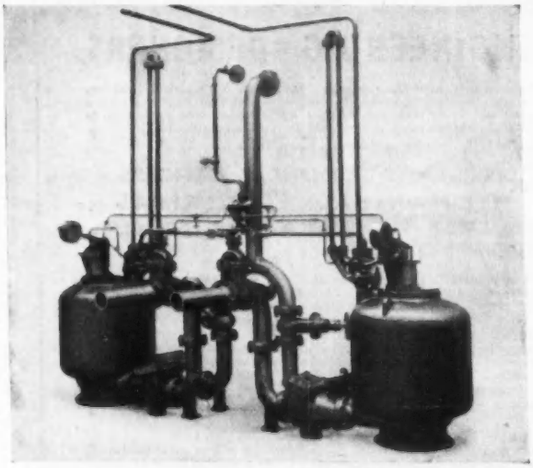
Efficient SEWAGE HANDLING EQUIPMENT

THE "CLEARWAY" PUMP
(HORIZONTAL TYPE)

Will handle liquids containing solid matter without choking. Of exceptionally robust construction, driving direct by electric motor, or by belt or engine. Available also as a vertical pump



"SHONE" PNEUMATIC AUTOMATIC EJECTOR



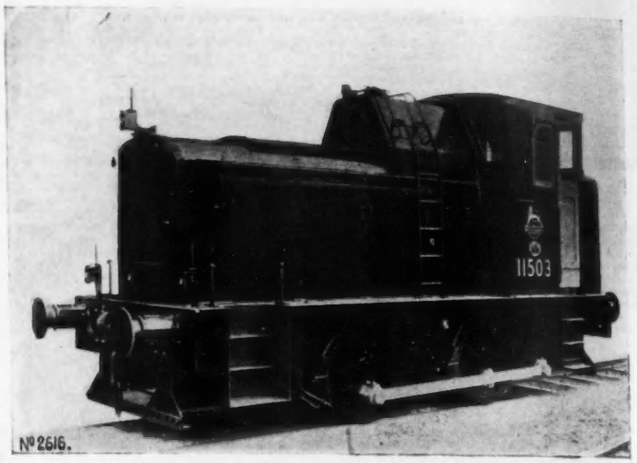
For raising unscreened sewage, sludge, trade wastes, chemical liquids, etc., and conveying to any other point. Simple construction, using compressed air as motive power, with a minimum of moving parts, functioning for long periods without attention. Detailed schemes submitted for any project.

HUGHES & LANCASTER LTD.
ENGINEERING WORKS · ACREFAIR - WREXHAM · DENBIGHSHIRE
TELEPHONE: RUABON 2102/3
London Office: 9 Upper Belgrave Street, S.W.1
Telephone: SLOane 8172/3

A MEMBER OF THE BUTTERLEY GROUP

E36

BARCLAY
LOCOMOTIVES
DIESEL • STEAM • FIRELESS
(Coal or oil fired)



One of several 153 H.P. diesel locomotives built for British Railways

Andrew Barclay Sons & Co. Ltd.
CALEDONIA WORKS KILMARNOCK
Telegrams: "BARCLAYSON KILMARNOCK" Telephone: Kilmarnock 1366/7
LONDON OFFICE: 38 VICTORIA STREET, WESTMINSTER
Telegrams: PLATCO, SOWEST, LONDON Telephone: ABBey 6407

BIRD'S

GEARS & GEAR CUTTING, PROFILE GROUND GEARS, COMPLETE REDUCTION UNITS

W. H. BIRD & SONS LTD.
ST. PHILIPS, BRISTOL 2
'Phone: Bristol 77033 'Grams: Ormonic, Bristol

GEARS Bristol

A CUT ABOVE ALL OTHERS

We are not surprised that a good tool dealer will invariably recommend ECLIPSE when he is asked for a Saw. He knows that tools bearing a famous name will give long efficient service, and with an eye to future business prefers to recommend the tool that will uphold his judgment. A fundamental part of the reliability that is synonymous with the name ECLIPSE is the die cast handle supplied by us. As the demand for quality die castings has risen it has been a matter of regret that for some time we have been unable to accept orders from new customers. In order to meet these demands we have undertaken a major development programme. The installation of a considerable amount of plant is now complete, enabling us once again to turn our attention to enquiries from new customers.

Photograph by Permission of Jas. Neill & Co. (Sheffield), Ltd.

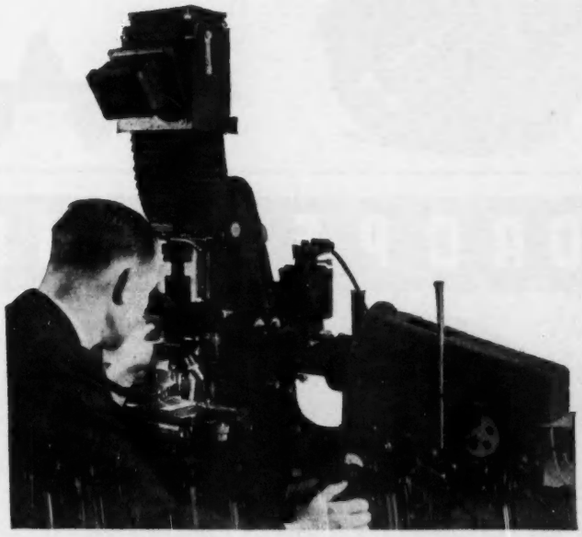
30 YEARS' ANGLO-AMERICAN DIE CASTING EXPERIENCE

WOLVERHAMPTON DIE CASTING
AFFILIATED WITH
PRECISION CASTINGS CO. INC. (U.S.A.)

THE WOLVERHAMPTON DIE CASTING COMPANY LTD.

GRAISELEY HILL WORKS, WOLVERHAMPTON.
TELEPHONE 23831/6

In search of
THE RIGHT SOLUTION



FOR the efficient cleaning and degreasing of every known metal and alloy there is an "S.A.C." specific. For treatment in circumstances complicated by unusual conditions—the answer can be found by the "S.A.C." technicians. Consultation with "S.A.C." is the shortest, most economical way of finding the right solution for your metal cleaning problems. We have the equipment of today—the experience of many years.

PRODUCTION PROVED PRODUCTS

SUNBEAM ANTI-CORROSIVES LTD.

CENTRAL WORKS · CENTRAL AVENUE
WEST MOLESEY · SURREY

Telephone: Molesey 4484 (5 lines)
Telegrams: Sunanticor, East Molesey

Manufacturers of
STRIPALENE · FERROCLENE · ALOCLENE · FERROMEDE · BRAZOCLENE
(Regd. Trade Marks)
APPROVED BY ADMIRALTY, WAR OFFICE AND AIR MINISTRY

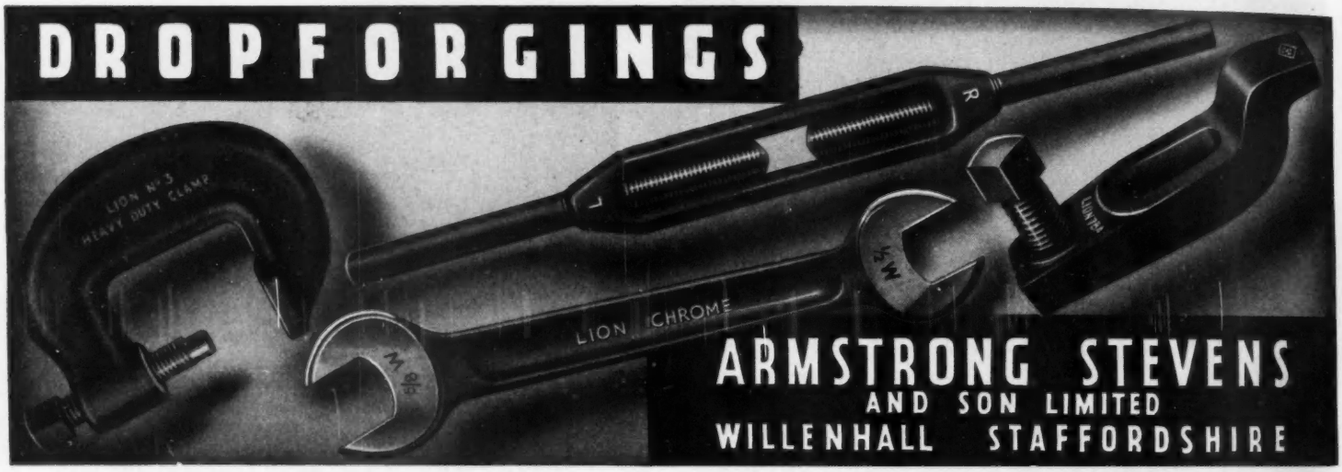
CONVEYOR AND ELEVATOR Co (1936) LTD.

BULL BRIDGE WORKS,
Accrington, Lancashire.

Telephone No. 2779.
Telegrams: "Conveyor" Accrington.

SPIRAL CONVEYORS,
BUCKET ELEVATORS, Etc.

DROPFORGINGS



ARMSTRONG STEVENS
AND SON LIMITED
WILLENHALL STAFFORDSHIRE

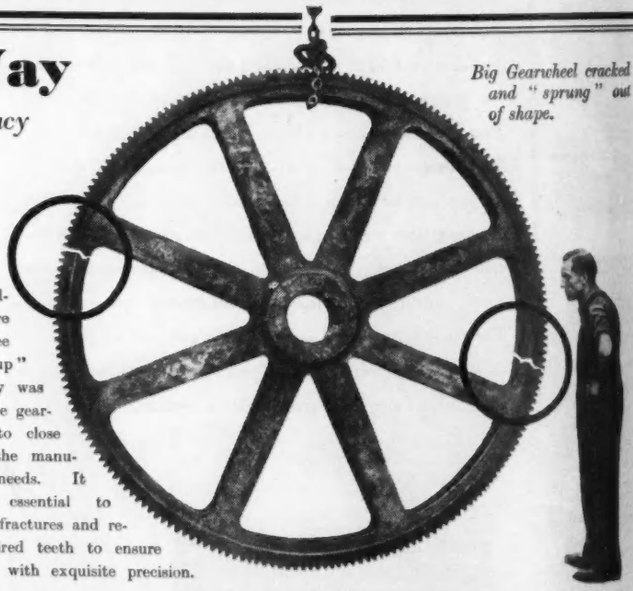
The Wheel & the Way

A BARIMAR Triumph of Strength and Accuracy

This hefty injector gearwheel "Went West"—perhaps it would be more accurate to say it went "South", where Barimar welders put it to rights again.

Note the immense size of this vital member of the processing plant of an important chemical works. It was cracked through the rim in two places, and had "sprung" out of shape where fractured. This gearwheel had to carry a heavy load, so that the welding definitely had not only to ensure meticulous accuracy but to guarantee that the repair would "stand up" to enormous strain. Accuracy was particularly important, for the gearwheel had been made to close tolerances to meet the manufacturers' special needs. It was, therefore, essential to "draw-in" the fractures and reshape the repaired teeth to ensure correct meshing with exquisite precision.

Guaranteed BARIMAR



Big Gearwheel cracked and "sprung" out of shape.

REPAIRED AND GUARANTEED BY BARIMAR
The fractures were "drawn in" and accuracy of wheel restored to makers' fine tolerances.
HALF-A-CENTURY OF WELDING SERVICE TO INDUSTRY!

When set up after repair and carefully checked, the fine accuracy of Barimar Scientific Welding was proved to the hilt. This difficult job was completed in a few days at insignificant cost, compared with the expense of a new gearwheel. Further, the repair was covered by the Barimar Money-Back Guarantee—familiar hallmark of Scientific Welding well and conscientiously done.

ALL BROKEN PARTS which are transportable must be sent CARRIAGE PAID or delivered to the nearest Barimar Branch. Please remove all fittings and post letter advising despatch. When it is impossible to transport machinery, Barimar experts operate ON THE SPOT.

BARIMAR LTD.

Barimar House,
22-24, Peterborough Road,
FULHAM, LONDON, S.W.6.

Telephones: RENown 2147-2148. Night 2148. Telegrams: "Bariquamar, Walgreen, London"

BARIMAR Branch Addresses
BIRMINGHAM, 12: 116-117 Charles Henry St. *Phone: Midland 2696*
MANCHESTER, 13: 67 Brunswick St., Ardwick. *Phone: Ardwick 2738*
NEWCASTLE UPON TYNE, 1: 64-66 The Close. *Phone: 21055*
GLASGOW, C.2: 134 West George Lane. *Phone: Central 4709*

BARIMAR—The World's Scientific Welding Engineers

". . . nothing but the BEST is good enough . . ."

MESSRS. ROLLS-ROYCE LTD. specified 'DELTA' alloys (Brass and Bronze) for use in their "DERWENT" engine units for the record breaking jet-propelled 'GLOSTER METEOR' aircraft

for best results specify always:

'DELTA' NON-FERROUS METALS AND ALLOYS

THE DELTA METAL COMPANY LTD. LONDON AND BIRMINGHAM

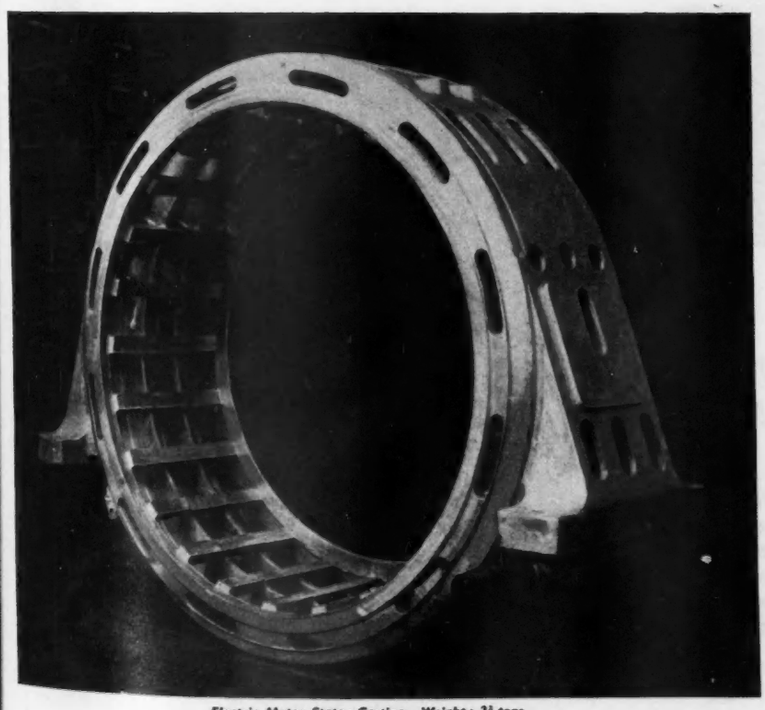
S-B-C

Waste Heat Recovery Plant

Specialists in the design and construction of Steam-Raising Plant, utilising waste gases, in the Gas, Chemical and Ceramic Industries; also the Iron and Steel Industries. Heat-recovery from internal combustion engines and similar prime movers in Land and Marine Installations. A direct method of saving fuel.

SPENCER - BONECOURT - CLARKSON LTD

14 - 15 FETTER LANE · LONDON · E.C.4. Phone: Fleet Street 0481 and 6181

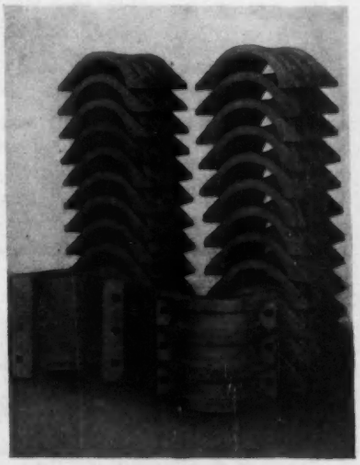


Electric Motor Stator Casting. Weight: 2½ tons.

COMPREHENSIVE RANGE OF GREY IRON CASTINGS FROM A FEW POUNDS TO TEN TONS IN WEIGHT, MACHINED OR UNMACHINED

PRODUCTION BY MODERN MACHINES EMPLOYING SYNTHETIC AND NATURAL SANDS.

EXAMPLES OF ←LOAM & MACHINE→ MOULDED CASTINGS.

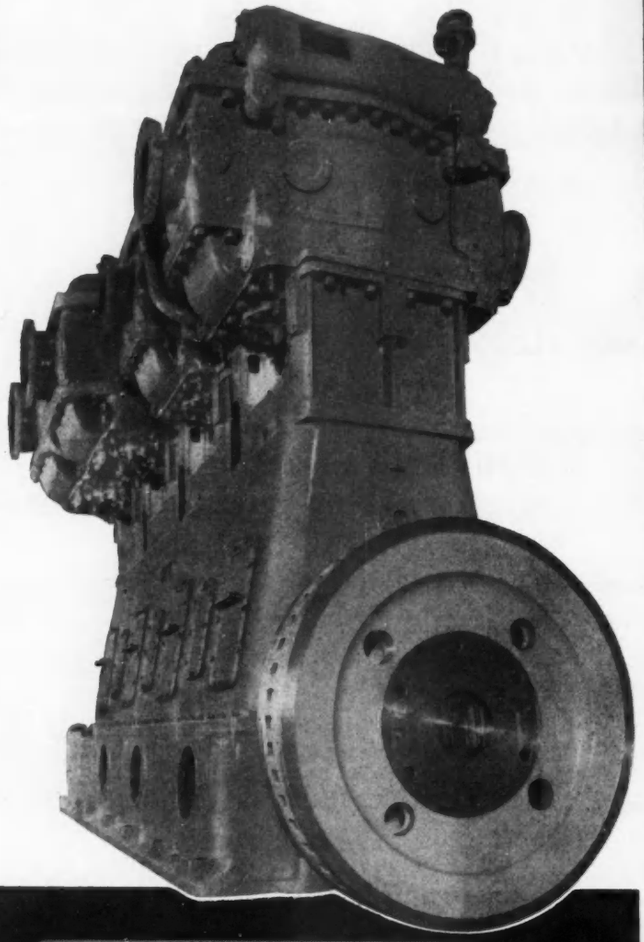


Split Collar Castings. Weight - 32 lbs each.

C. & W. WALKER LTD.

DONNINGTON Nr. WELLINGTON - SHROPS

LONDON OFFICE 70 VICTORIA ST. S.W.1.



ALLEY

Compressors

are the development of 50 years endeavour to produce the finest machine of its type

Completely modern in design and materials—built with a large safety factor to ensure long periods of continuous operation and to deliver the stated output of clean air on low power consumption. In standard ranges or to meet special requirements. All accessories, made to the same high standard, are available.

COMPRESSORS ..... Capacities up to 12,000 c.f.m.
VACUUM PUMPS ..... Displacements up to 15,000 c.f.m.
STEAM ENGINES ..... Power Outputs up to 750 b.h.p.

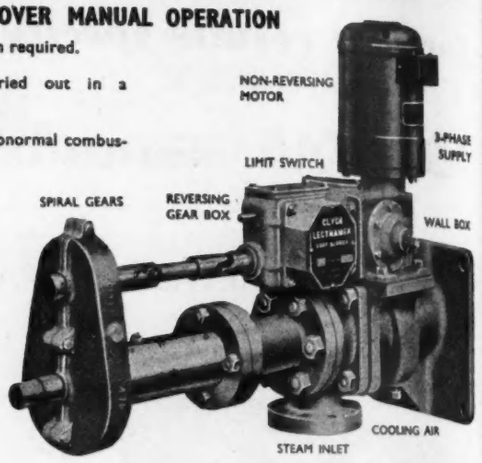
ALLEY & MACLELLAN
(POLMADIE) LTD., GLASGOW, S.2

Also licensed to manufacture Gas Compressors to the designs of
CLARK BROS. CO., OLEAN, U.S.A.

Clyde SOOT BLOWERS
BOILER AVAILABILITY INCREASED
ELECTRO-MECHANICAL OPERATION with SEQUENCE CONTROL

IMPROVEMENTS OVER MANUAL OPERATION

1. No physical exertion required.
2. Soot blowing carried out in a quarter of the time.
3. Shorter period of abnormal combustion conditions.
4. Cleaner heating surfaces with higher and sustained rate of evaporation.
5. Saving in fuel and labour costs.
6. Increased boiler availability.



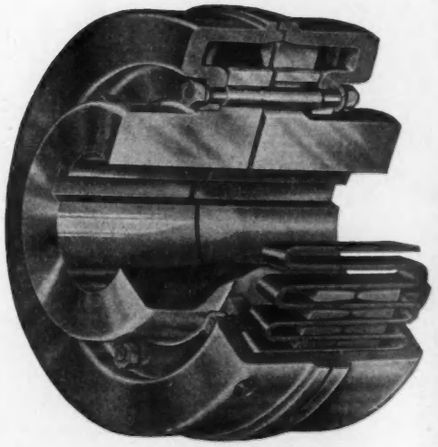
London:—
34, VICTORIA ST., S.W.1
Telephone: ABBey 1847

Manchester:—
1, CHANCERY LANE, SPRING GARDENS, 2
Telephone: DEAnsgate 4262
Telegrams: "MURWILS"

CLYDE BLOWERS LTD
LIVINGSTONE STREET, CLYDEBANK

TELEPHONE: CLYDEBANK 1576/77 *TELEGRAMS:* "MURWILS," GLASGOW

BIBBY COUPLINGS



THE WELLMAN BIBBY CO. LTD.
PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1
Telegrams: COUPLINGS, SOWEST, LONDON **Telephone: ABBey 1194**

Instrumentally Speaking . . .

The extreme versatility of the world-famous AvoMeter is not enough for some people in industry and in sea-going ships. At the request of such people, the Avo Industrial Test Set has been evolved. It comprises a Model 40 Universal AvoMeter and specially designed accessories to extend the wide ranges of measurement already provided for in the meter itself.

It is capable of dealing with practically all electrical measurements likely to be encountered in normal industrial or marine use, up to 4,800 volts on A.C. and D.C., and up to 480 amps D.C. or 240 amps A.C.

The instrument meets the requirements of the Air Registration Board and the Merchant Shipping (Radio) Rules, 1952.

Model 40 Universal AvoMeter ..... List Price: £19 : 10s.

Avo INDUSTRIAL TEST SET ..... List Price: £35 : 9s.

Write for a free copy of the latest Comprehensive Guide to "Avo" Instruments.

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
Avocet House, 92-96, Vauxhall Bridge Road, London, S.W.1 *VICtoria 3404 (9 lines)*

And it will be just as fresh and clean as in the countryside if it has been purified by Heather Multi-brush Air Filters. For Heather Filters adopt Nature's principle of cleaning the air by means of a fine screen of intermingling hairs. Like nature, too, they do their work efficiently, and maintenance is extremely simple—there are no messy fluids to apply and nothing to replace. Get in touch with us if you have an air filtration problem.

HEATHER FILTERS LIMITED

48 ST. JAMES'S PLACE, LONDON, SW1 HYDE PARK 7588

TONNAGE OXYGEN PLANTS

and gas separation plants

British Oxygen Linde offer the combined experience and technical resources of two great companies—The British Oxygen Company Limited and Linde Gesellschaft—designers and manufacturers of oxygen, nitrogen and gas separation plants for more than fifty years.

BRITISH OXYGEN LINDE LIMITED

Bridgewater House, St. James's, London, S.W.1

STEEL CASTINGS

Produced by Electric Arc Process and Modern Plant

For - -

Rolling Mills - Melting Plants - Engineers, etc.

★

We can supply MACHINED when required

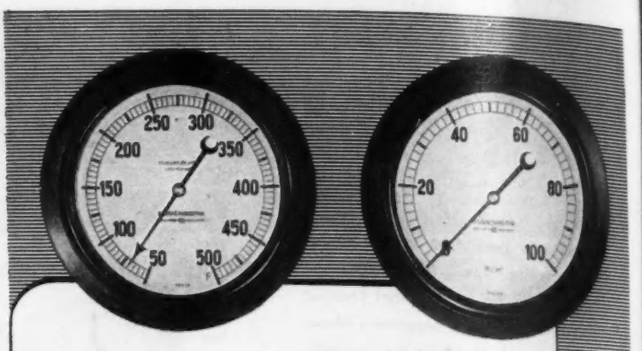
W. SHAW & CO. LTD.

WELLINGTON STEEL FOUNDRY

MIDDLESBROUGH

Telephone: 3441 (P.B.X.)

Telegrams: Wellington, Middlesbrough



FLUSH MOUNTING

PRESSURE GAUGES & THERMOMETERS

The appearance of your Instrument panel can be greatly improved by using Budenberg Gauges and Thermometers. This is achieved by uniformity of style throughout the wide Range in which they are manufactured. Fixing is by clamp, and no screws or screw holes if required. Write for full details.

Budenberg

BUDENBERG GAUGE CO. LTD

BROADHEATH Nr. MANCHESTER

Regency House, 1-4 Warwick St., London, W.1 Tel: GERrard 4822-3 'Grams: Pyrometer, Piccy, London.

62 Robertson Street, Glasgow, C.2

dmBU/6

TUBE BENDING MACHINERY

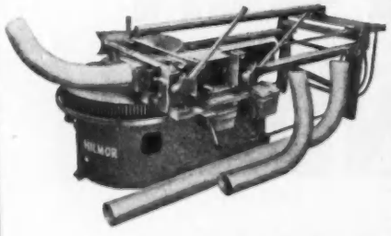
HILMOR LIMITED produce the largest and most varied range of light gauge tube bending machinery made in Great Britain. Included are:—

★ Portable Hydraulic machines to bend Gas and Steam, light gauge copper and steel tube, etc.

★ Mandrel machines for the production of full bore extra short radius bends cold and without filling.

★ Hand operated and motorised heavy duty general purpose benders.

Illustrated is model MD.46. Produces full bore bends unfilled on short radii up to 6in. dia. non-ferrous tube and 4in. dia. light gauge ferrous tube.



HILMOR MACHINES ARE USED FOR THE PRODUCTION OF:—

★ EXHAUST PIPES
★ CYCLE HANDLEBARS
★ TUBULAR FURNITURE
★ TRANSFORMER BENDS
★ REFRIGERATION COILS
★ HEATING COILS
★ TRAPS AND SYPHON
★ PIPE LINE INSTALLATIONS, ETC.

HILMOR LTD. (Sales & Service)

the brains behind the bending business

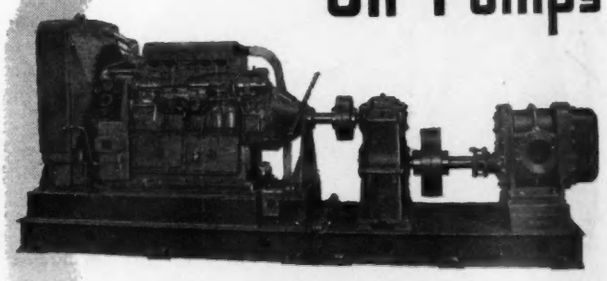
CAXTON WAY, STEVENAGE, HERTS.

Phone: STEVENAGE 881. Grams: TUBENDERS, STEVENAGE.

DRUM ROTARY PISTON PUMP

150/100,000 g.p.h. Temperatures up to 600°F.

Cargo Oil Pumps



DRUM Pumps meet the requirements of the petroleum industry in a unique way, and are suitable for liquid from the most volatile to the most viscous, over a wide range of temperatures. Cargo, bunkering, transfer, road tanker, refuelling pumps etc.

THE DRUM ENGINEERING COMPANY LIMITED

HUMBOLDT STREET, BRADFORD • Telephone: Bradford 22358

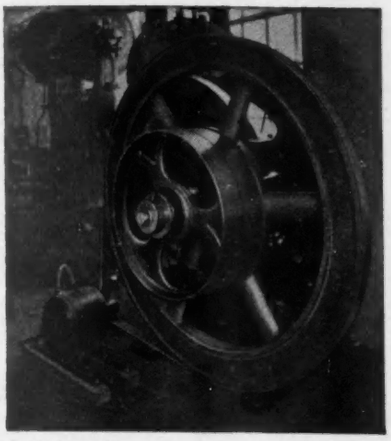
London Office: 38, Victoria Street, Westminster, S.W.1. Telephone: ABBey 7961

Branch Offices in Glasgow, Newcastle, Manchester and Birmingham

DR 56

STEPHENS
Miraclo
deals with difficult drives

- ★ RATIOS ABOVE 20:1
- ★ SPEEDS UP TO 10,000 f.p.m.
- ★ POWERS UP TO 500 h.p.
- ★ SHORTEST CENTRES
- ★ STARTING SLIP NIL
- ★ SHOCK LOADS ABSORBED



5 H.P. Coining Press Drive Pulleys 4" & 66" dia. Ratio 16½:1. 3" Miraclo Belt

MIRACLO, the plastic belt with the chrome leather driving face, succeeds where other belts have failed : that has been *proved by test in every industry*. And the saving is terrific! One manufacturer reports a saving of £3,400 in one department; another reports that output has increased by more than 33⅓% since using MIRACLO. A leading aircraft manufacturer reports that *MIRACLO belts are lasting twenty times as long as other belts.*

OUR BROCHURE GIVES YOU ALL THE FACTS

Thousands of engineers have already solved their power transmission problems by reading our 12 page colour brochure, which includes full details on how to design a MIRACLO drive.

POST THIS COUPON TODAY FOR YOUR COPY

To :- STEPHENS BELTING COMPANY LTD
SNOW HILL, BIRMINGHAM 4.
Please send *without obligation* the Stephens Miraclo Belt Drive brochure No. 101

FIRM'S NAME .....

.....

ADDRESS .....

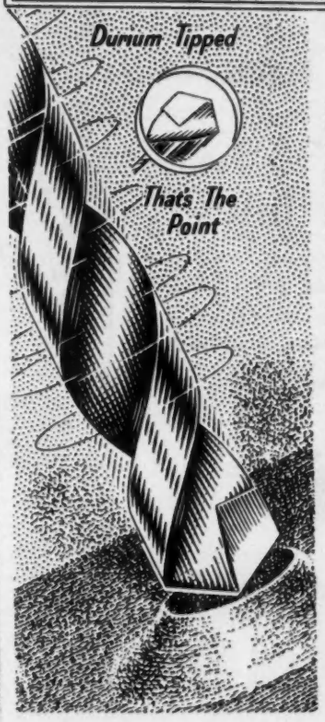
.....

ATTENTION OF.....

POSITION .....

S.40a

The NEW *improved* 'Durium' Drill clears spoil as it cuts



CUTS FASTER - LASTS LONGER COSTS NO MORE

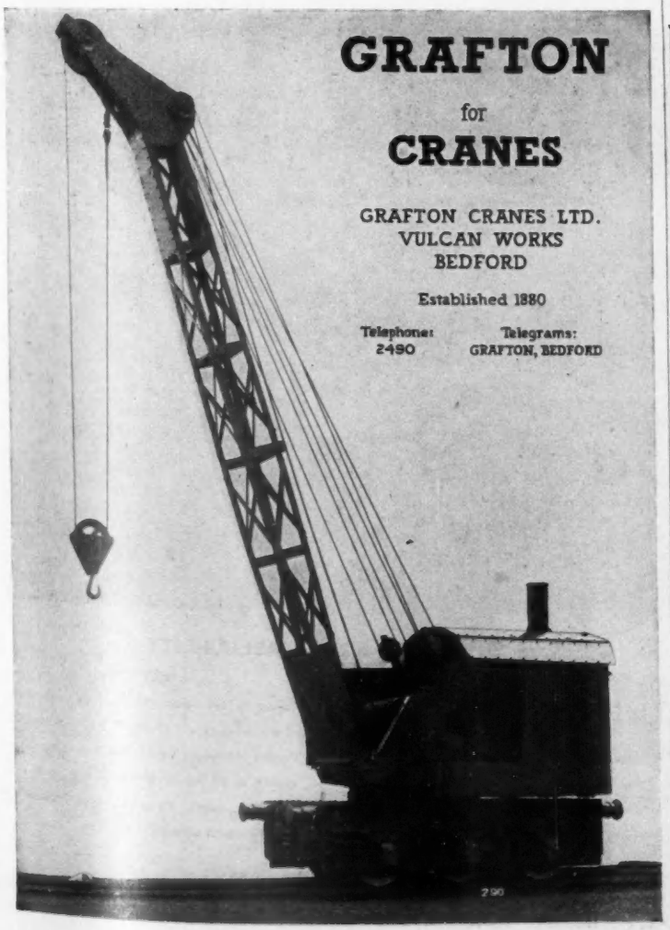
It's exclusive to Durium Drills—the completely new patented flute profile which expels the spoil continuously and automatically without clogging or packing even in deep holes and damp brickwork. With this new improved Durium Tipped Drill, clean, round holes are made in masonry, faster than ever before.

This new flute profile also has the dual advantage of providing a stronger than ever backing to the "DURIUM" tip. The result—the finest masonry drill manufactured today. You must use them on your next masonry drilling job. They can be used in hand or suitable electric drills. *Free descriptive folder will be sent on request.*

NEW IMPROVED
RAWLPLUG
DURIUM
Registered Trade Mark
RAPID CLEARING TYPE DRILLS FOR MASONRY AND ALL TILES

8Sc6

THE RAWLPLUG COMPANY LIMITED
CROMWELL ROAD, LONDON, S.W.7



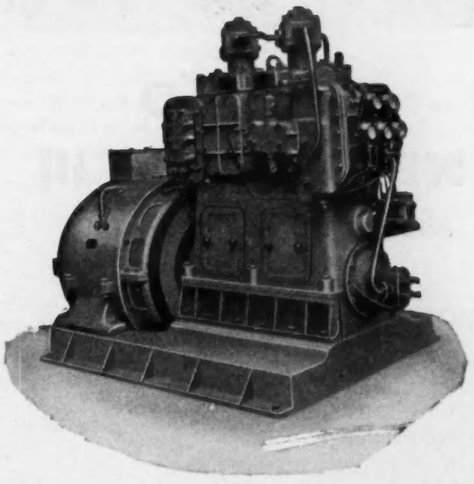
GRAFTON
for
CRANES

GRAFTON CRANES LTD.
VULCAN WORKS
BEDFORD

Established 1880

Telephone: 2490
Telegrams: GRAFTON, BEDFORD

AIR COMPRESSORS for DIESEL SHIPS



This shows our latest 3-stage Vertical Enclosed Marine Type Diesel Auxiliary Compressor, with Forced Lubrication, direct coupled to an Electric Motor. Machines may also be arranged for Steam Driving, and have either one or two cranks, depending on the output.

For full particulars, write to Dept. B.

REAVELL & CO., LTD., IPSWICH

Telegrams: REAVELL, IPSWICH.
Telephone: Nos.: 2124 & 2125.

Today, more than ever, industry looks to ERMETO for efficient high-pressure pipe lines

Whatever the field of application you will find ERMETO valves and couplings have played a notable part in raising the standard of efficiency.

Technical literature gladly sent on request.

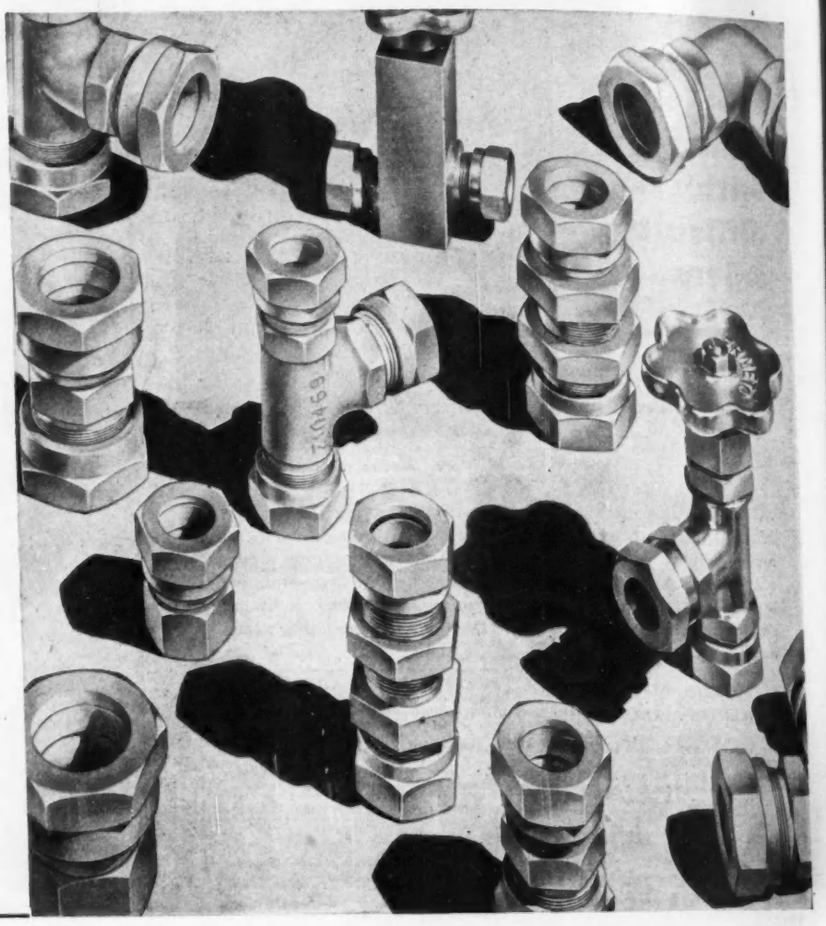
ERMETO

REG. TRADE MARK

VALVES AND COUPLINGS

BRITISH ERMETO CORPORATION LIMITED

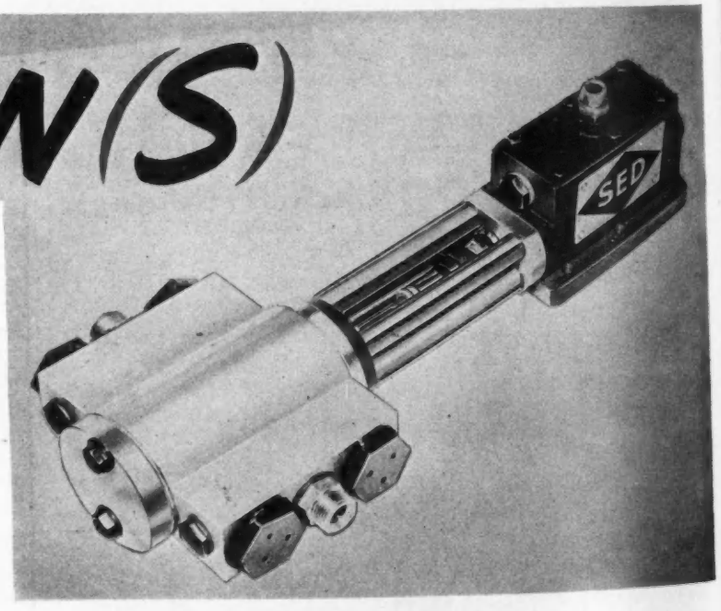
Maidenhead, Berks. Tel.: 2271/4



THIS IS NEW(S)

The S.E.D 'NEUMO' Mk. III

PNEUMATICALLY OPERATED PUMP UNIT



THE MOTOR

- ★ Two moving parts only.
- ★ Hardened and ground piston and valve.
- ★ Cast iron body with honed bore.
- ★ Non-stalling.
- ★ Negligible air consumption.
- ★ High power output.

THE PUMP

- ★ Double acting.
- ★ High efficiency.
- ★ Self-contained valves.
- ★ Easily serviced.
- ★ Pumps liquids up to 200 deg. F.

SIMPLICITY MEANS RELIABILITY

TYPICAL PERFORMANCE FIGURES		
Air Pressure	60 lbs. P.S.I.	60 lbs. P.S.I.
Consumption	2½ Cu. F.P.M.	2½ Cu. F.P.M.
Delivery	45 gals. P.H.	120 gals. P.H.
Del. Pressure	30 lbs. P.S.I.	5 lbs. P.S.I.

WIDE RANGE

Owing to the design and materials employed in its construction, the "Neumo" Mk. III Pump Unit is capable of handling a very wide range of materials such as paint at 200 deg. F., petrol, oils, from paraffin to high viscosities, Solvex, Mangersol, Basol, Trichlorethylene and all types of cellulose solvents, etc.

Send for further details to:—

(Dept. EG), KINGSBOURNE PRODUCTS LTD., SOUTH COAST ROAD, PEACEHAVEN, SUSSEX Tel. Peacehaven 2115

PRESSED STEEL

sections : trench sheeting : roadforms :

Valley and boundary wall gutters.

PRESS BRAKE WORK OF ALL DESCRIPTIONS

including holing and welding as required.

DORMAN LONG (STEEL) LTD. AYRTON ROLLING MILLS, MIDDLESBROUGH
London Office : Terminal House, 52 Grosvenor Gardens, S.W.1. Telephone : SLOane 2275

DORMAN LONG

SOME C.E.A. POWER STATIONS USING BAILEY'S VALVES

BIRKENHEAD
BLACKBURN
BOLD
BRIGHTON
BRUNSWICK WHARF
CARMARTHEN BAY
CLYDES MILL
DONCASTER
DRAKELOW
HACKNEY
HARDINGSTONE
HUDDERSFIELD
HAYLE
INCE
KEADBY
KINGSTON
LITTLEBROOK
STELLA NORTH
STELLA SOUTH
THORNHILL
TILBURY
WAKEFIELD

C.E.A. CHOOSES BAILEY'S VALVES

Many of the nation's major power stations depend upon sluice and reflux valves supplied by Sir W. H. Bailey & Company Limited. Backed by more than a century's experience the company provides a standard range of high quality valves from 2 to 54-inch bore for pressures up to 150 p.s.i. Advice is gladly given on any special purpose applications and a Special Contracts Department is maintained to deal with valve schedules on large contracts anywhere in the world.

Engineers and valve users should write for Bailey's 'Index List', which outlines the full range of the company's products.

54-inch Bailey's Sluice valve installed at Hardingstone Power Station. Two 39-inch, four 42-inch and two 54-inch sluice valves were supplied by Bailey's for this contract. They are designed for operation by both local and remote control.

A 54-inch Bailey Check valve specified for Thornhill Power Station.

Bailey's
VALVES

Sir W. H. Bailey & Co. Ltd. • Head Office and Works: Patricroft, Lancashire
Telephone: Eccles 3487-8-9 Telegrams: Beacon, Eccles
LONDON OFFICE: 4, Domingo Street · London · E.C.1. Telephone: CLErkenwell 0791/2

SLUICE VALVES · REDUCING VALVES · TEST PUMPS · TURNSTILES

9 words...

please supply full details of Major Industrial Equipment Units...

in a telegram . . .

. . . could provide your company with a full and complete answer to power problems in the equipment they manufacture or use. The 9 word enquiry, via the post, telephone or in a telegram, is a natural first move in any project involving power. A move which may mean the saving of thousands of £'s on later production cost. 9 words and a few shillings — a small investment for such a large, promising return.

Designers have the basic details in Designer's Corner . . . Sales Departments also, have their own section . . . and the address is at the bottom of the page !

DESIGNER'S CORNER

SALES DEPARTMENT'S SECTION

Major Industrial Equipment Units are available in 4 basic combinations :—

1. Engine + transmission.
2. Engine + transmission + hydraulics.
3. Engine + transmission + hydraulics + steering.
4. Engine + transmission + hydraulics + steering + front axle.

Other combinations can include Rear Power Take Off, 2-speed Belt Pulley, alternative clutch and gear housings etc. In all, over 100 standard combinations.

Engine Details:	Diesel	Petrol	Vap. Oil
Cubic Capacity	3.61 litres	3.261 litres	3.61 litres
Compression Ratio	16 : 1	5.5 : 1	4.35 : 1
Brake Horse Power at :—			
1200 RPM	32.0	32.5	31.5
1400 RPM	36.5	36.5	35.5
1600 RPM	40.5	35.5	38.5

Specifications and performance data available on request. Individual queries welcomed by the Industrial Sales Department.

Major Industrial Equipment Units could provide your equipment with these *extra* advantages :—

- The lowest priced Diesel Power Unit, in its power class, in the World.
- Over 100 alternative units available — *all* at standard cost.
- Quality and precision of Ford Engineering brings absolute reliability to the equipment you sell.
- Small unit — big power — with consequent savings in fuel costs for your customers.
- Ford Service facilities are World-Wide. Standardised spares at low, fixed prices are alway available.
- In the future, more and more of your customers will be looking for Major Industrial Power in the equipment they buy.

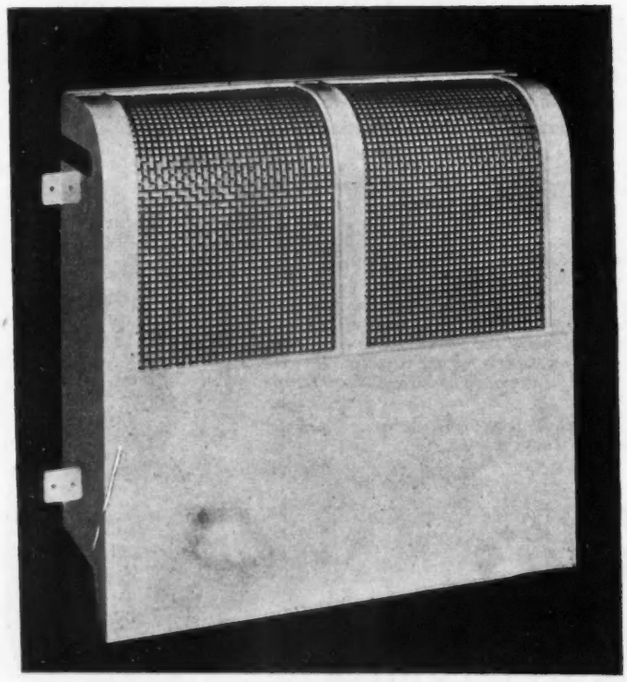
ALL enquiries to : *Phone : RAinham 3000 · Grams : Fordmotor, Telex, Dagenham*

INDUSTRIAL SALES DEPARTMENT · TRACTOR DIVISION · FORD MOTOR COMPANY LIMITED · DAGENHAM · ESSEX

SEE **FORDSON** *FIRST*

ALEXANDER McARA

DUNDEE COPPER WORKS



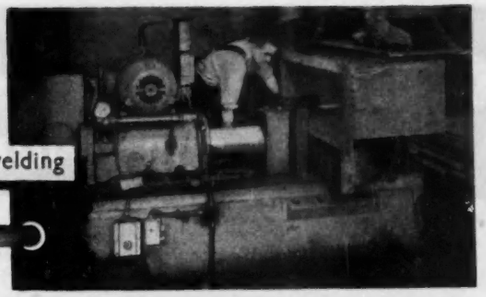
Mild steel radiator cover finished in stove enamel and fitted with flat brass mesh, heavily chrome-plated. Supplied for Marine and Industrial purposes.

All descriptions of Copper, Brass, Sheet Metal and Stainless Steel work.

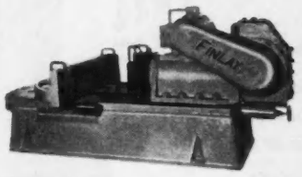
Telephone : DUNDEE 81268-9

Works : EAST DOCK STREET, DUNDEE

FINLAY PRESSES



Cleaning up distortion after welding



Model
R100 EB

Flange Forming

This standard Finlay 100-ton press forms steel sections up to 13in. by 5in. RSJ or 6in. rounds. With variable bending blocks and a ram head which can be changed in a matter of seconds it can be adapted for hundreds of steel-forming purposes.

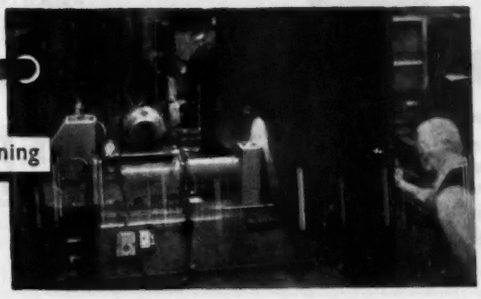


Plate Straightening

F Write for details:

FINLAY ENGINEERING LTD.

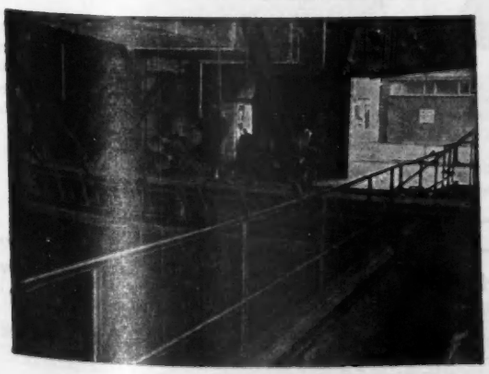
Dept. EG NEWPORT Phone: 62210 & 62219. MONMOUTH Grams: Finlay, Newport, Mon. ENGLAND

Photographs by courtesy of Messrs. Bruce Peebles & Co. Ltd. Edinburgh 5.

'OWL'
VIBRATOR CONVEYORS

At work in many of the largest plants in the country.

One of several sets handling hot ashes from Boiler Plant at a large Power Station.



HANDLING—

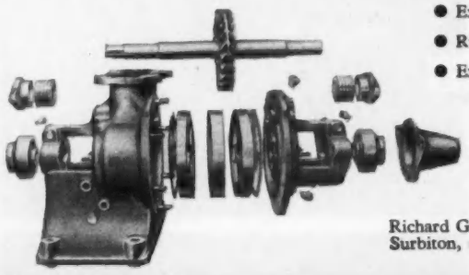
Hot Sinter : Chemicals : Coal
Coke : Cement : Oxides
Sand : Gravel : Grain : etc.

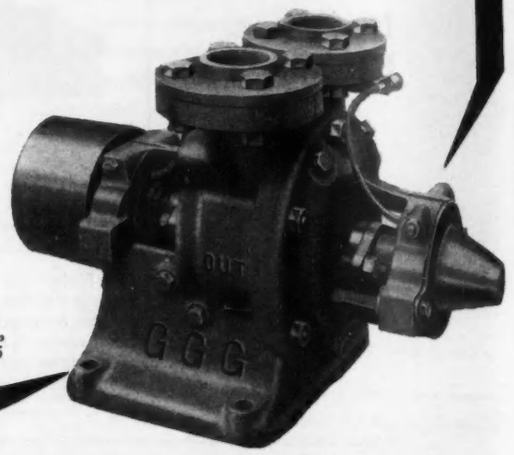
WRITE FOR TECHNICAL BROCHURE

OWL ENGINEERING SUPPLIES LTD.
16 SOUTH PARADE, DONCASTER.
'Phone: Doncaster 49656/7/8

'GGG' HEAVY DUTY SELF-PRIMING PUMPS FOR INDUSTRIAL PURPOSES

- For Belt, Motor or Engine Drive
- Heads up to 700 feet
- Output up to 200 G.P.M.
- Suction lifts up to 28 feet
- Constructed in special metals for most liquids
- Handles air and water
- Renewable bronze internals
- Stainless steel shaft
- External ball bearings
- Rustless gland assembly
- Excellent service facilities





London area distributors for service and spares :
Richard Grosvenor & Co., Ltd., 54 Victoria Rd., Surbiton, Surrey. Tel.: Elmbridge 6755

GILKES PUMPS

GILBERT GILKES & GORDON LTD

PUMP & WATER TURBINE MANUFACTURERS

KENDAL Telephone: Kendal 28 ENGLAND

London Office: CRAVEN HOUSE, KINGSWAY, LONDON W.C.2. Telephone: HOLBORN 3231/2

G 30A

ABBOT

Machine Cut GEARS

of all kinds—
to specification in any material.

We guarantee the teeth of all wheels cut by us to be correct, and all work is examined and checked before being despatched. Each gear wheel of a pair is run in correct relative position to the other in a special gear-testing machine. No perceptible backlash is allowed in our gearing, and thus we can ensure very silent running.

ABBOT ENGINEERING COMPANY LIMITED

Uniformly Fine Gears

Our booklet "MACHINE CUT GEARS" contains much information of interest and use to engineers. A copy will be sent on request.

The ABBOT ENGINEERING Co. Ltd.,
22 SMITHHILLS · PAISLEY
Telephone; PAISLEY 4272 *Telegrams: "ABBOT, PAISLEY."*

SPUR WHEELS · SPIRAL WHEELS · RACKS · WORM GEARING · BEVEL WHEELS · FIBRE PINIONS

The HYDRA LITE RANGE OF TANGYE JACKS lift so easily

"Lightest Jack in the World"

Everybody concerned with lifting or displacing heavy weights should know about the advantages of the 'Hydralite' super lightweight jacks. The 15 tons capacity weighs only 24 lb. Normally, jacks in this higher tonnage range take two or more men to move them. A 'Hydralite' is easily lifted by one man and shows a saving in manpower and operator fatigue.

PARTICULARS OF THE 'HYDRALITE' RANGE

Model	Capacity (tons)	Weight (lb.)	Power Lift (in.)	Closed Height (in.)
6515	15	24	6·5	11·375
625	25	32	6	11·5
650	50	61	6	13
1215	15	38	12	18·25
1225	25	53	12	18·875

SEND TODAY FOR 'HYDRALITE' LIST
or for help on your hydraulic problems

TANGYE HYDRAULIC DIVISION

BUILT ON A CENTURY OF HYDRAULIC EXPERIENCE

TANGYES LIMITED · SMETHWICK · BIRMINGHAM · ENGLAND

A WAY FOR AIR...

AND GAITERS FOR RAMS

Here is industry's most versatile ducting — SPIRATUBE. For mine ventilation or machine shop abrasives—for hydraulic rams or chemical fumes—factories, garages, tunnels, aircraft. There are special types of SPIRATUBE for almost every ducting need, in many coverings and sizes.

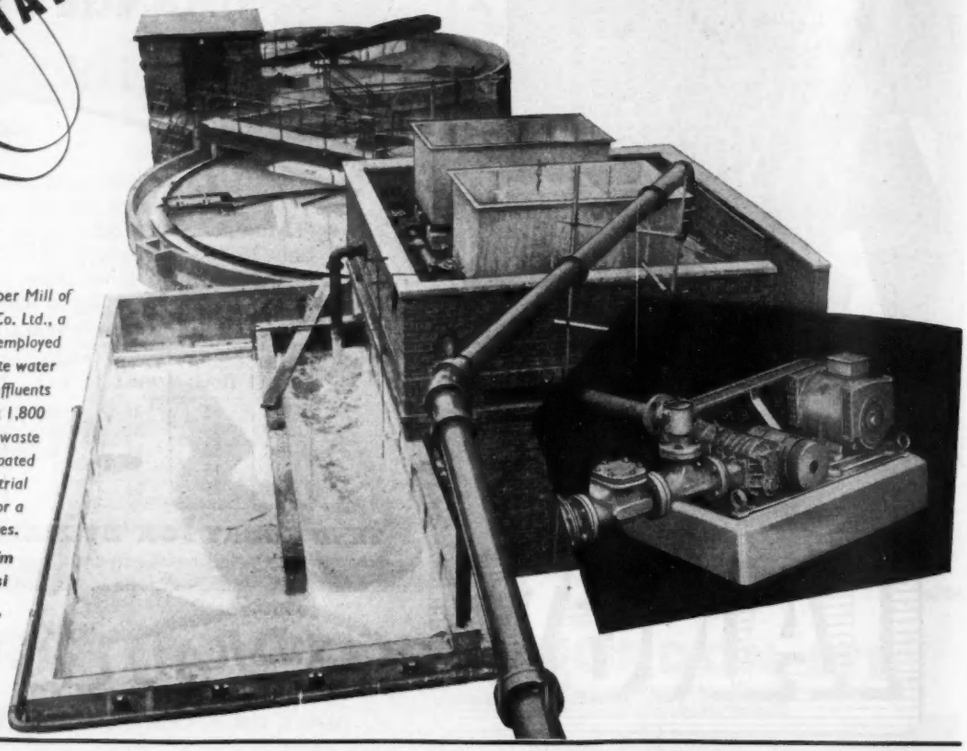
SPIRATUBE is fitted quickly and simply. You can do it yourself—there are no heavy hangers . . . no special elbows . . . no structural alterations. SPIRATUBE is available in diameters from 3 inches to 30 inches ready to serve you in any air or airborne job.

Write today for the SPIRATUBE booklet which illustrates what this versatile ducting will do. Put your problem up to our design engineers. They will be glad to advise you without cost or obligation. The address is Flexible Ducting Limited, Maryhill, Glasgow.

AN ASSOCIATE COMPANY OF GEORGE MACLELLAN & CO. LTD. ESTABLISHED 1870

FLEXIBLE DUCTING LIMITED, MARYHILL, GLASGOW, N.W.
Telephone: MARyhill 3729 Telegrams: Flexiduct, Glasgow, N.W.

FLUID AGITATION...



In the Aylesford Paper Mill of Messrs. Albert E. Reed & Co. Ltd., a Godfrey Model K 200 industrial blower is employed to recover fibrous material from waste water by flotation and to mix thoroughly different kinds of effluents prior to sedimentation. The blower, driven at 1,800 r.p.m., supplies 50 c.f.m. of oil free air to agitate waste water in a tank; fibrous material is thereby floated to the surface and then removed. Godfrey industrial blowers are widely used in industry for a variety of processes.

PERFORMANCE: flows up to 3,500 cfm at pressures up to 10 psi

ALSO AVAILABLE: vacuum pumps, gas boosters, relief valves etc.

GODFREY
SIR GEORGE GODFREY & PARTNERS (IND.) LTD.

SIR GEORGE GODFREY & PARTNERS (Industrial) LTD.

HANWORTH · MIDDLESEX
TELEPHONE: FELTHAM 3291 *CABLES: GODFREPART, LONDON*
Associated Companies in CANADA, AUSTRALIA, SOUTH AFRICA

Wellman *Mobile* Forging Manipulators Furnace Chargers Handlers

Specially designed for their purpose

Operate in restricted areas.

Afford good visibility to operator.

Equipped with electric motor or diesel engine prime mover driving pump unit at constant speed.

Hydraulically operated in all motions.

Infinite variation of speed — no gear changing.

Specially constructed to withstand overloads and shocks.

Efficient gripping for Manipulators and Handlers.

Grip heads can be stopped accurately.

Cushioned resilience for Forging Manipulators.

Easy access to all parts to facilitate maintenance.

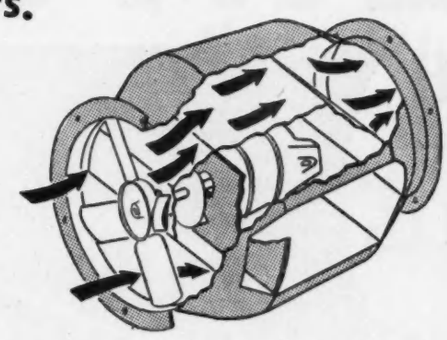
THE WELLMAN SMITH OWEN ENGINEERING CORPN. LTD.
PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1 WORKS: DARLASTON, SOUTH STAFFS.

SOME FANS GET RID OF CORROSIVE FUMES

(but corrosive fumes get rid of some fans!)

The choice is yours.

SIMPLE
SAFE
CERTAIN



But before choosing consider the "Tornado" BIFURCATED FAN range. Here, at last, is a fan which is more than a match for the most stringent demands. Corrosive, inflammable, or excessively hot fumes or gases are treated with contempt.

And have you noticed the design?—see how the fumes flow through the substantial steel casing—see how the motor is sealed-off from the fumes yet open to atmosphere—see how the whole compact unit is built for easy installation, even in existing pipe lines.

This is, in fact, the fan for you.

Publication No. 28/2 awaits your request.

Tornado

BIFURCATED FANS
(with sealed-off motors)

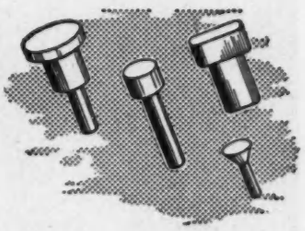
EX-STOCK

Keith Blackman
LIMITED

Mill Mead Road, London, N.17
'Phone: Tottenham 4522
and at Manchester, Birmingham, Leeds, Glasgow, Newcastle-on-Tyne, Bristol, Cardiff and Belfast.

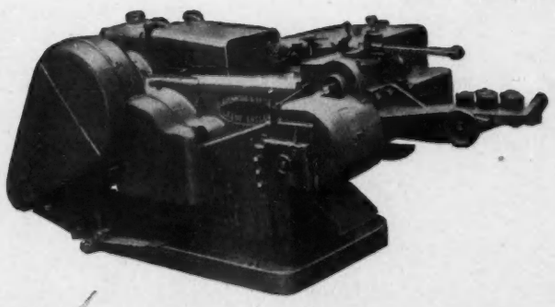
T.A. 5843/556

Comparable in accuracy and finish with machined products



Cold Forging

greater economy in material and cost with.....



For the production of cold forged bolts, screws and many other similar components, we can furnish complete equipment, giving results fully equal in precision and finish with those produced by machining, at much lower cost per piece

GREENBAT COLD FORGING MACHINES

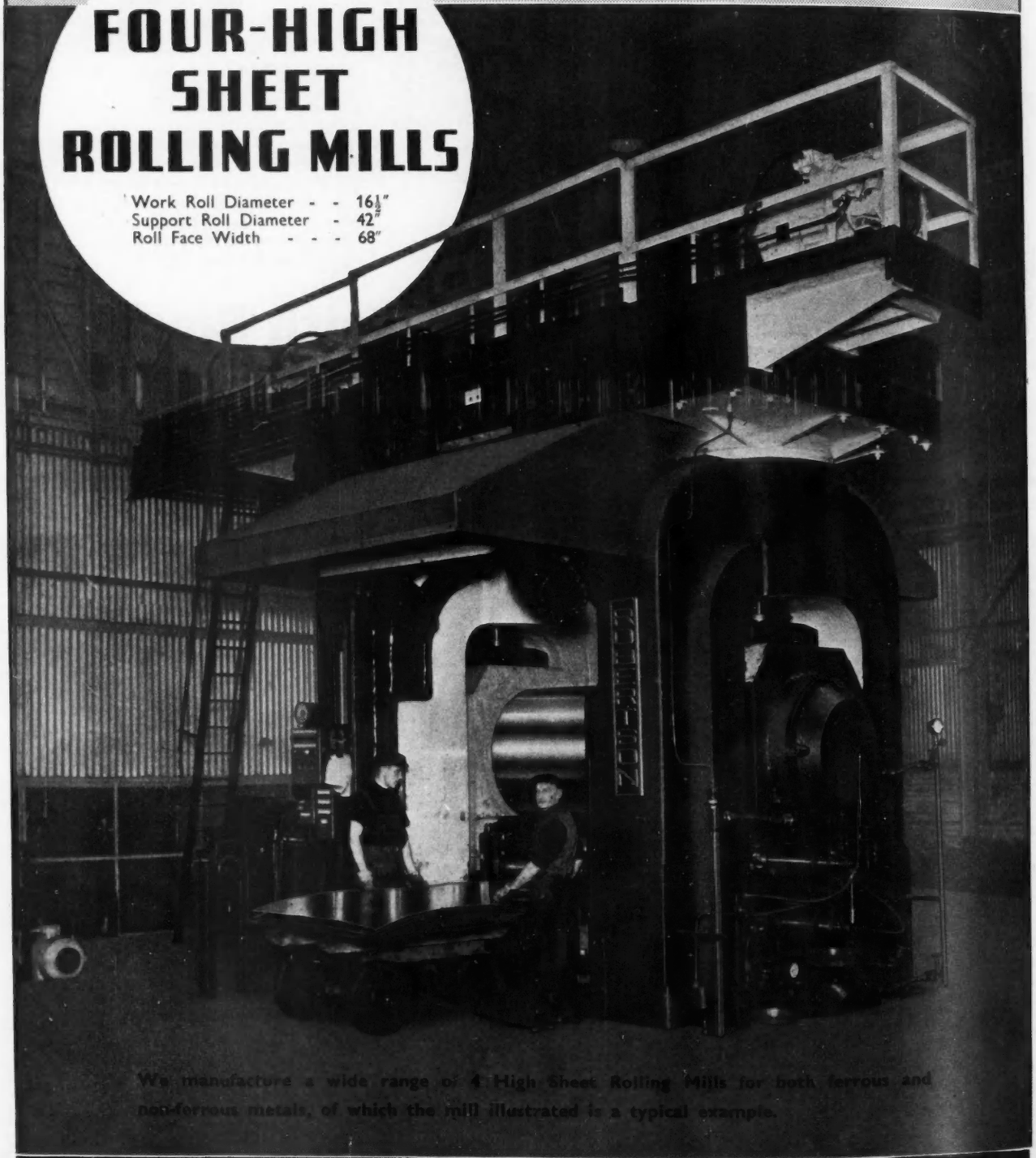
GREENWOOD AND BATLEY LIMITED · ALBION WORKS · LEEDS

CH 17

ROBERTSON

FOUR-HIGH SHEET ROLLING MILLS

Work Roll Diameter - - 16½"
Support Roll Diameter - 42"
Roll Face Width - - - 68"

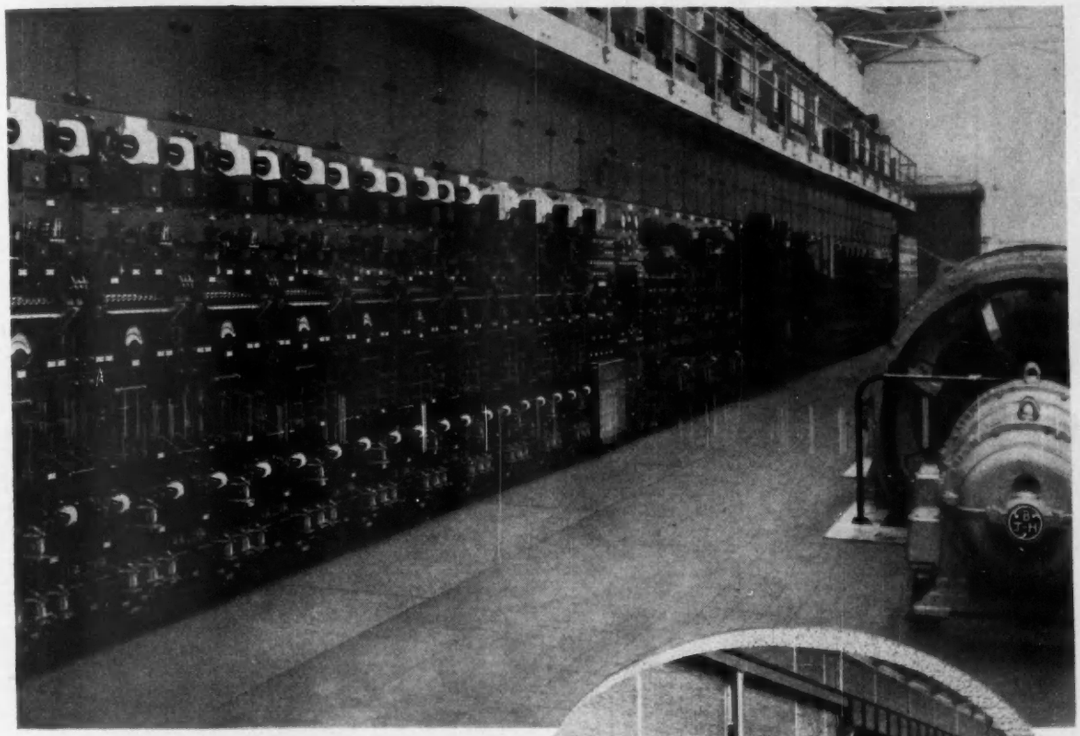


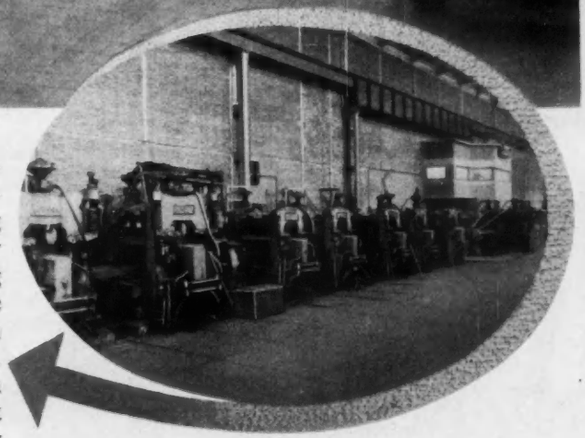
We manufacture a wide range of 4 High Sheet Rolling Mills for both ferrous and non-ferrous metals, of which the mill illustrated is a typical example.

W. H. A. ROBERTSON & CO. LTD., BEDFORD, ENGLAND

LICENSEES FOR THE BUILDINC OF SENDZIMIR COLD REDUCTION MILLS & PLANETARY HOT MILLS

CONTACTOR CONTROL for Heavy Industry





The CONTACTOR EQUIPMENT illustrated is controlling seventeen motors totalling 6,850 h.p., a 6,000 h.p. motor driving a motor-generator set, and various other auxiliary drives. Inset is shown the roughing train of the Merchant Rod Mill at the Tremorfa Works of Messrs. Guest, Keen and Nettlefolds (South Wales) Ltd., Cardiff. For more than forty years BTH has held a position of leadership in the development of automatic "finger-tip" control of heavy electric plant through the medium of contactors. These contactors, designed by experts, are proved by protracted "life tests" before going into service.

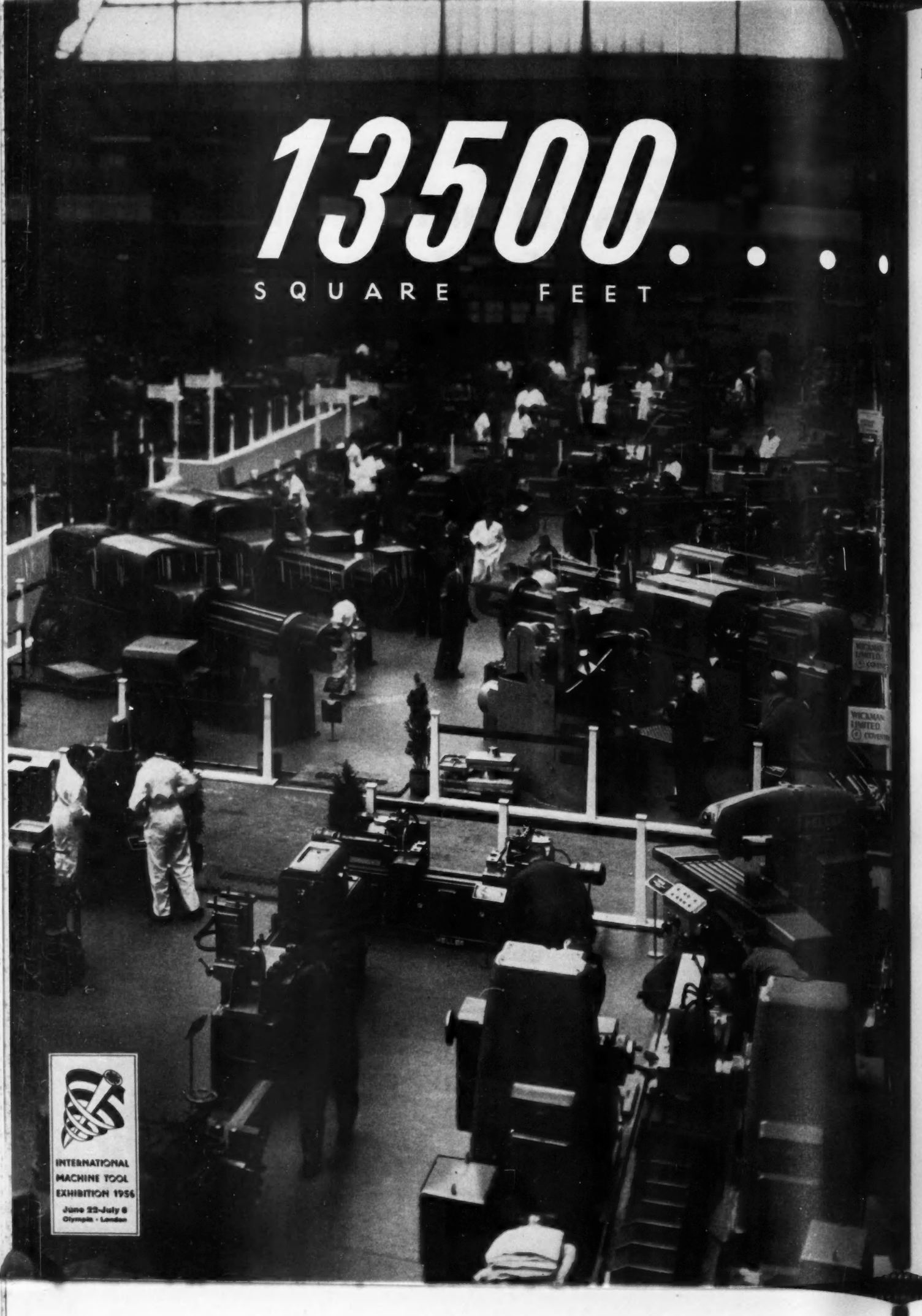
Where only the best is good enough—

Specify BTH Contactor Control

THE
BRITISH THOMSON-HOUSTON
COMPANY LIMITED, RUGBY, ENGLAND

Member of the AEI group of companies

A4316


13500....
SQUARE FEET
INTERNATIONAL
MACHINE TOOL
EXHIBITION 1956
June 22-July 6
Olympia · London

to display biggest ever

Wickman

exhibit

The Wickman exhibit at this year's International Machine Tool Exhibition will be the largest ever presented by the Company.

Covering 13,500 square feet of stand space and including over one-hundred machine tools in addition to a wide selection of ancillary equipment, the Wickman exhibit will demonstrate the latest techniques in metal-cutting, grinding and honing, forging, and sheet-metal forming.

In tune with to-day's needs, high production is the key dominating the demonstrations which will be a continuous feature of the show, with something to make everyone's visit worth-while. Be sure to visit us.

WICKMAN LIMITED

MACHINE TOOL DIVISION · BANNER LANE · COVENTRY

Where to go and what to see —

STAND 112
National Hall

Wickman Automatics.
Wickman Optical Profile Grinding Machines.
Wickman Erodomatics.

STAND 118
National Hall

Carlstedt Deep-Hole Boring Machines.
Collet & Engelhard Horizontal Boring Machines.
Duchscher-Wecker Hammering Machines.
Eumuco Forging Equipment.
Heller Milling Machines.
Herlan Extrusion Presses.
Klopp Shaping Machines.
Kopp Profile Milling Machines.
Lorenz Gear Shaping & Hobbing Machines.
Maypres Toggle Presses.
Nagel Honing Equipment.
Naxos-Union Grinding Machines.
Pines Tube Benders.
Tibo-Yoder Tube Mills and Roll Forming Equipment.
Weingarten Presses.
Weipert Lathes.
Wickman-Moulton Thread Milling Machines.

STAND 119
National Hall

Davenport Multi-spindle Automatics.
Warner & Swasey Chucking Lathes.

STAND 110
National Hall

Losenhausenwerk Balancing and Testing Equipment.

STAND 318
Grand Hall Gallery

Wimet Tungsten Carbide Tools.
Wickman Tool Grinding Equipment.
Neven Metal-Bonded Diamond Wheels.
Spedia Resinoid-Bond Diamond Wheels.
Wickman Cinema.

STAND 525
Empire Hall Gallery

Cary Inspection Equipment.
Dubied Copying Lathes.
Etamic Gauging Equipment.
Habib Tool Grinders.
Hauser Jig Boring & Jig Grinding Machines.
Lambert Precision Gear Hobbers.
Mipsa Grinding Machines.
Ortlieb Tap, Die and Drill Grinding Machines.
Safag Clock and Precision Instrument Manufacturing Equipment.
Schaublin High Precision Lathes and Milling Machines.

STAND 641
Empire Hall Gallery

Wickman Administration and Reception Offices.

Also

STAND 32
Grand Hall

Planers (Huddersfield) Ltd.
Planing Machines.

STAND 111
National Hall

Webster & Bennett Boring & Turning Mills.

STAND 120
National Hall

Arthur Scrivener Ltd.
Centreless & Surface Grinding Machines.

STAND 414
National Hall Gallery

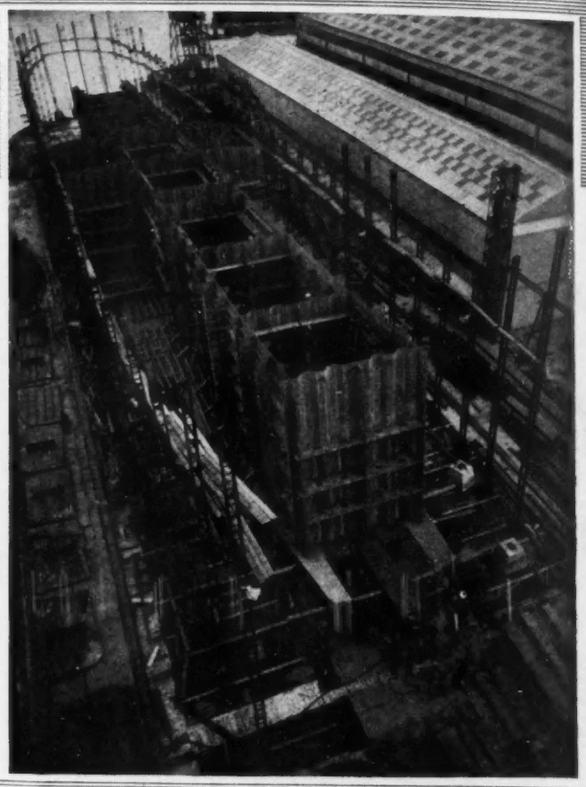
Heenan & Froude Ltd.
Wire and Strip Forming Machines.

445W

APPLEBY-FRODINGHAM

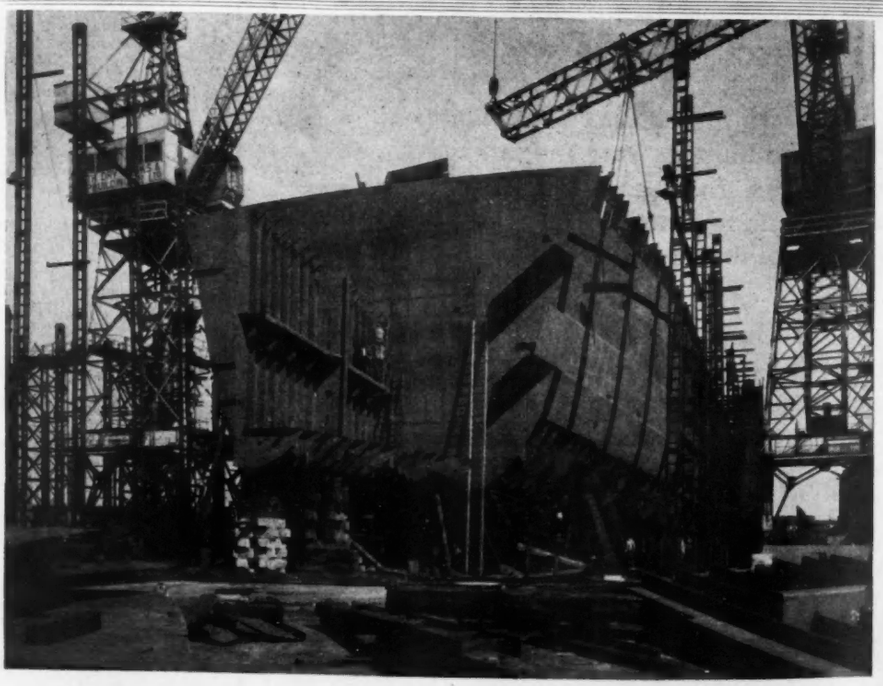
STEEL PLATES AND SECTIONS

The 18,000 ton tanker "William G. Walkley" here shown building for Ampol Petroleum Ltd. by Blyth Dry Docks and Shipbuilding Co. Ltd., Blyth, incorporates large quantities of Appleby-Frodingham Plates and Sections.



Right : Showing the centre cargo tanks erected ; both the transverse and longitudinal bulkheads are of corrugated plates troughed at the shipyard.

Right : Main bulkheads of corrugated plates and transverse side frames of 10" × 0·45 bulb flats. Note the fabricated deck panel in the foreground.



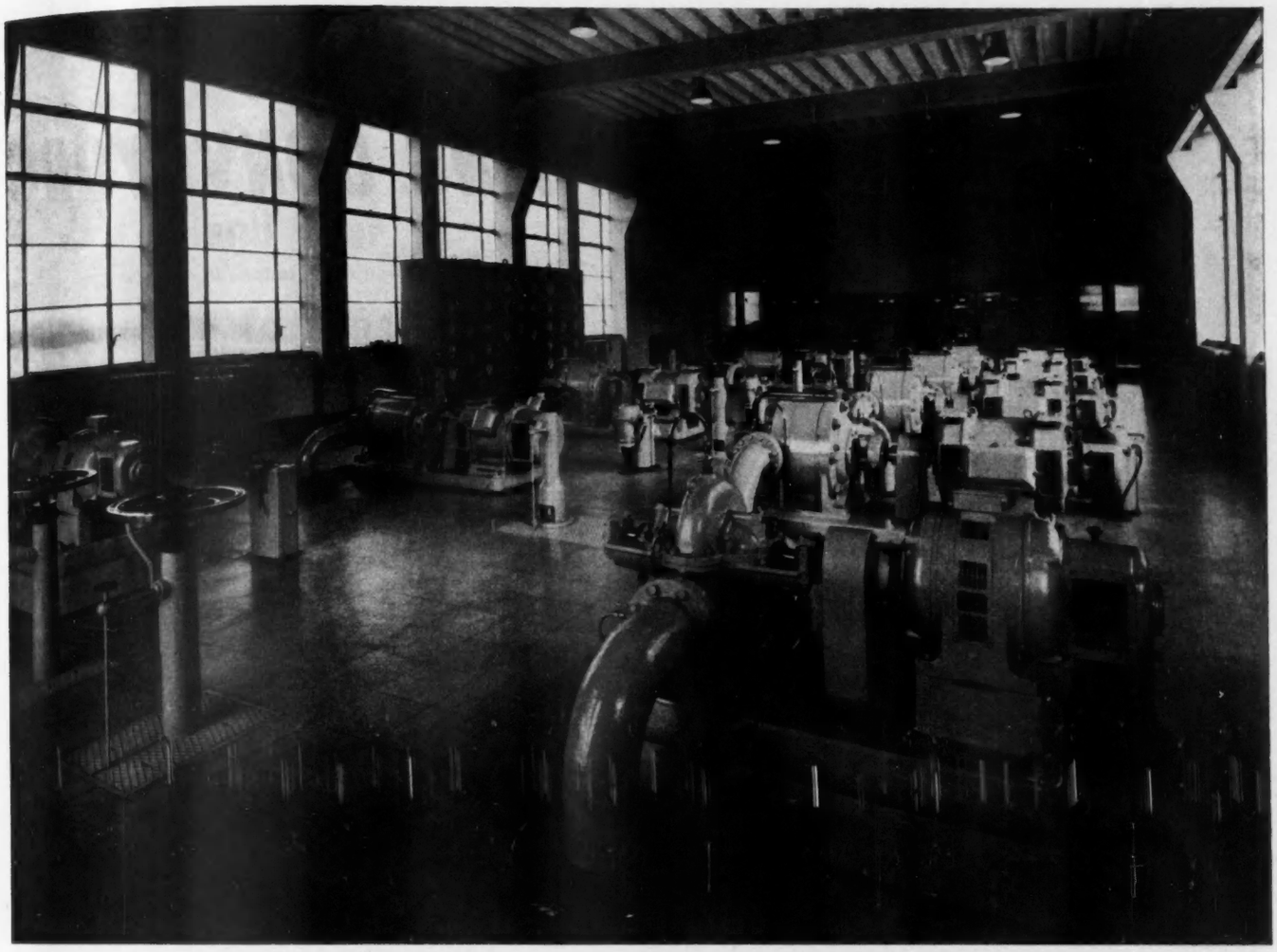
THE UNITED STEEL COMPANIES LTD

APPLEBY - FRODINGHAM STEEL COMPANY

SCUNTHORPE *Branch of The United Steel Companies Limited* LINCOLNSHIRE

Telephone : Scunthorpe 3411 (12 lines) *Telegrams : 'Appfrod' Scunthorpe*

AF.134



Stowey Pumping Station in which are installed 9 SULZER Centrifugal Pumps absorbing 599 B.H.P., having a capacity of 10·4 million gallons per day.

In connection with the CHEW VALLEY scheme of the BRISTOL WATERWORKS COMPANY
(R. W. Meivin General Manager)

a total of 24 SULZER PUMPING UNITS have been supplied including plant for the following

STOWEY · WITHYWOOD · HIGHRIDGE . DRY HILL · BARROW HILL
LODGE HILL · CHEDDAR and CHELVEY PUMPING STATIONS

SULZER
PUMPS FOR WATER SUPPLY

THERE IS A SULZER PUMP FOR EVERY PURPOSE

SULZER BROS. (LONDON) LTD., 31, BEDFORD SQUARE, LONDON, W.C.1
(INCORPORATING HATHORN, DAVEY & COMPANY, LTD.)

SULZER BROTHERS LIMITED HAVE OFFICES AT :— WINTERTHUR – PARIS – NEW YORK – MADRID – CAIRO – RIO DE JANEIRO – BUENOS AIRES – SHANGHAI – KOBE.
Agencies at :— BRUSSELS – MILAN – AMSTERDAM – LISBON – COPENHAGEN – OSLO – STOCKHOLM – HELSINKI – ATHENS – ISTANBUL – ALGIERS – JOHANNESBURG – HAIFA – BOMBAY
KARACHI – COLOMBO – SINGAPORE – BANGKOK – MANILA – MONTREAL – MEXICO CITY – BOGOTA – CARACAS – SANTIAGO (CHILE) – LIMA – LA PAZ – SYDNEY – MELBOURNE – WELLINGTON

LOST GRAVEL RECOVERED ON M&C FLOATING CONVEYORS

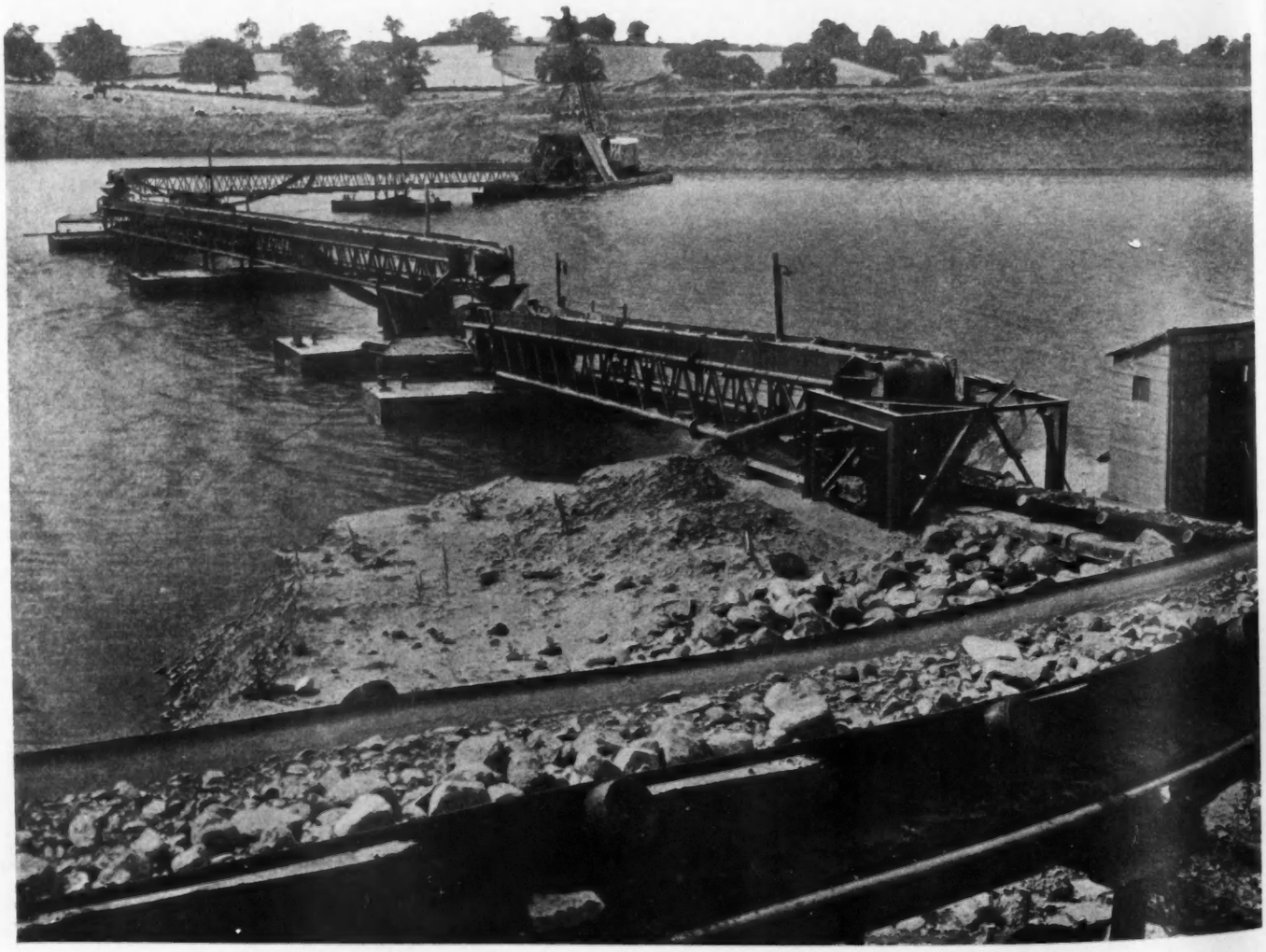
At Lingerfield Quarry, Knaresborough, about 600,000 cu. yds. of sand and gravel had been left under water, because the deposit could not well be worked from the shore deeper than 15 to 25 ft. Now it is being recovered by a grab, mounted on a pontoon, which delivers to three M&C floating conveyors hinged together.

The gravel is being won safely to the full depth over the whole area, and is carried to the plant in a continuous stream. There is no waiting, no unloading of barges, and no trouble with the large stones. The conveyors have done everything asked of them, and again proved themselves reliable in all weathers, ashore or afloat.

MAVOR & COULSON LTD

Bridgeton, Glasgow S.E. · Olive Grove Rd., Sheffield 2 · 36 Victoria St., London S.W.1

The three M&C conveyors on pontoons, bringing the gravel from the dredge. On land, more M&C conveyors complete the connection to the treatment plant, and also handle the output from the dry face. ★



Send your enquiry for castings in S.G. Iron to one of these licensed producers

J. Gordon Alison & Co. Ltd., BIRKENHEAD.

Argus Foundry, Ltd., GLASGOW.

Armstrong Whitworth (Metal Industries) Ltd., GATESHEAD-UPON-TYNE.

Henry Balfour & Co. Ltd., LEVEN, Fife.

Joseph Berry, Ltd., SWINTON, Lancs.

Birmidal Developments, Ltd., BIRMINGHAM 32.

Bradley & Foster Ltd., DARLASTON, Staffs.

Brightside Foundry and Engineering Co. Ltd., SHEFFIELD 1.

British Rollmakers' Corporation, Ltd., CREWE.

Cooper Brothers, Ltd., BURNLEY, Lancs.

Davy & United Engineering Co. Ltd., SHEFFIELD 4.

Duport Foundries, Ltd., TIPTON, Staffs.

Ferranti, Ltd., HOLLINWOOD, Lancs.

Fullwood Foundry Co. Ltd., MOSSEND, Lanarkshire.

Glanmorfa Foundry and Engineering Co. Ltd., LLANELLY.

R. Goodwin & Sons (Engineers) Ltd., STOKE-ON-TRENT.

Harland & Wolff, Clyde Foundry, Govan, GLASGOW.

Hepworth & Grandage, Ltd., BRADFORD.

Johnsons Rolls Limited, WEST BROMWICH, Staffs.

Lake & Elliot, Ltd., BRAINTREE, Essex.

Lloyds (Burton) Ltd., BURTON-ON-TRENT.

John M. Moorwood, Ltd., SHEFFIELD 9.

S. Russell & Sons, Ltd., LEICESTER.

Sandholme Iron Co. Ltd., TODMORDEN, Yorks.

Sheepbridge Equipment, Ltd., CHESTERFIELD.

Andrew Strang & Co. Ltd., HURLFORD, Ayrshire.

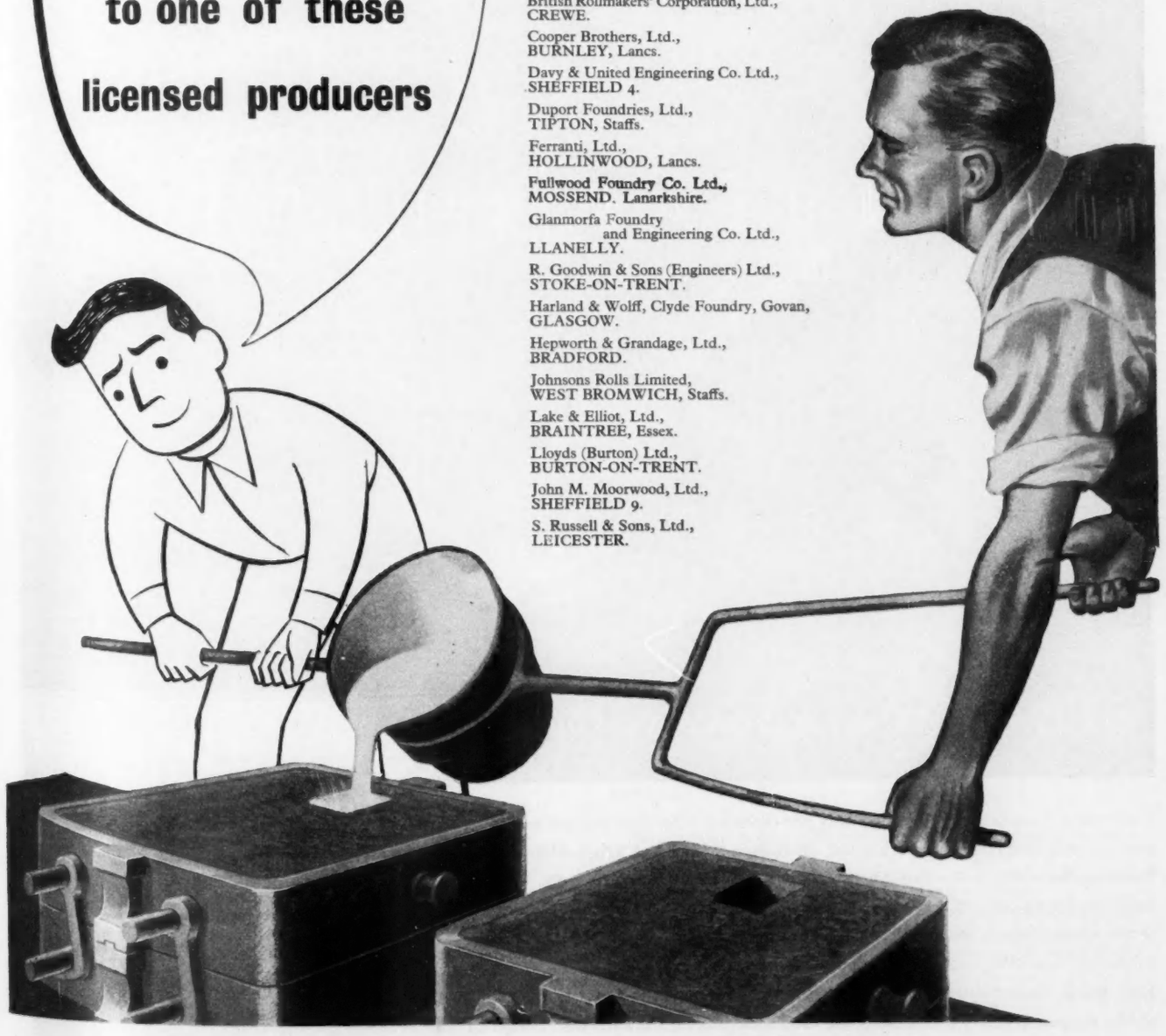
Robert Taylor & Co. (Ironfounders) Ltd., LARBERT, Stirlingshire.

Tees Foundries, Ltd., MIDDLESBROUGH.

Richard Thomas & Baldwins, Ltd., SWANSEA.

G. & J. Weir, Ltd., GLASGOW S.4.

John Williams & Sons (Cardiff) Ltd., CARDIFF.



THE MOND NICKEL COMPANY LIMITED · THAMES HOUSE · MILLBANK · LONDON · S.W.1

TGA 21/3L

Parker Progress

New Electric Furnaces double steel output

From your first contact with Parker Foundry you experience a personal attention and an interest in your design problems that is indeed refreshing in these days of "take it or leave it". To this understanding service Parker now add greatly increased production facilities. New machines, new processes and 25,000 sq. ft. of extra floor space, now help to make even better castings, faster. The new electric furnaces for instance have 9" dia. electrodes and transformer capacity of 2,500 kVo — to permit optimum melt control.

They double the production of low carbon steel of high magnetic permeability, and pearlite manganese steel of high tensility and exceptional wearing characteristics. *Always Consult Parker first, before you finalise on steel castings.*

PARKER

steel castings

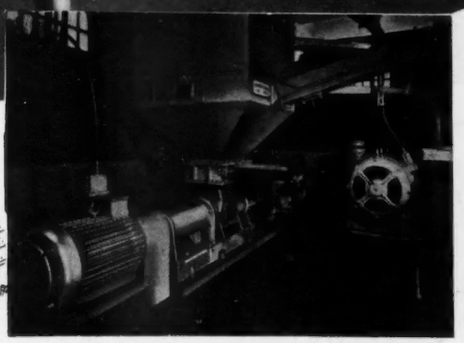
Manganese, Carbon & Alloy Steel.

PARKER FOUNDRY (1929) LIMITED · MANSFIELD ROAD DERBY · TELEPHONE DERBY 46055/6

A Parker for industry Ltd. Advertisement

HANDLING FLY-ASH THE EASY WAY

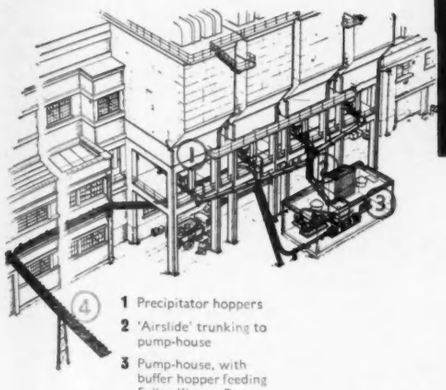
'Airslide' trunking, conveying fly-ash from precipitator hoppers to pump house



Interior of pump house, showing Fuller-Kinyon pump and 'Airslide' trunking entering buffer hopper

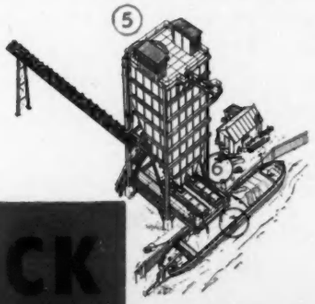
The
BABCOCK
LOW-PRESSURE PNEUMATIC SYSTEM

SIMPLE AND TROUBLE FREE



1 Precipitator hoppers
2 'Airslide' trunking to pump-house
3 Pump-house, with buffer hopper feeding Fuller-Kinyon Pump
4 Pipeline, pump-house to storage silo
5 Main dry-ash storage silo
6 Dust mixers, as used if dust is to be wet-conditioned for disposal
7 Discharge to barge

Ask for Publication 1646



A MODERN pulverized-fuel-fired power station or industrial boiler plant may produce from 500 to 2000 tons per day of fly-ash, which must often be conveyed over considerable distances for ultimate disposal. For handling such quantities over any distance, conventional methods of conveying by a vacuum system are inadequate.

The *modern* method is the *BABCOCK pneumatic system* using *low-pressure* air, by means of which the *dry* dust is made literally to flow *under gravity*, through a patented form of diaphragm ducting.

Fly-ash from any number of boilers is conveyed simply, cleanly and economically at rates from *20 to 100 tons per hour*, for distances up to *half a mile*.

The system is simple and trouble-free.

Its flexibility enables collection and discharge points to be most conveniently situated.

It is backed by the unrivalled experience of Babcock & Wilcox in dealing with large-scale ash and dust handling problems.

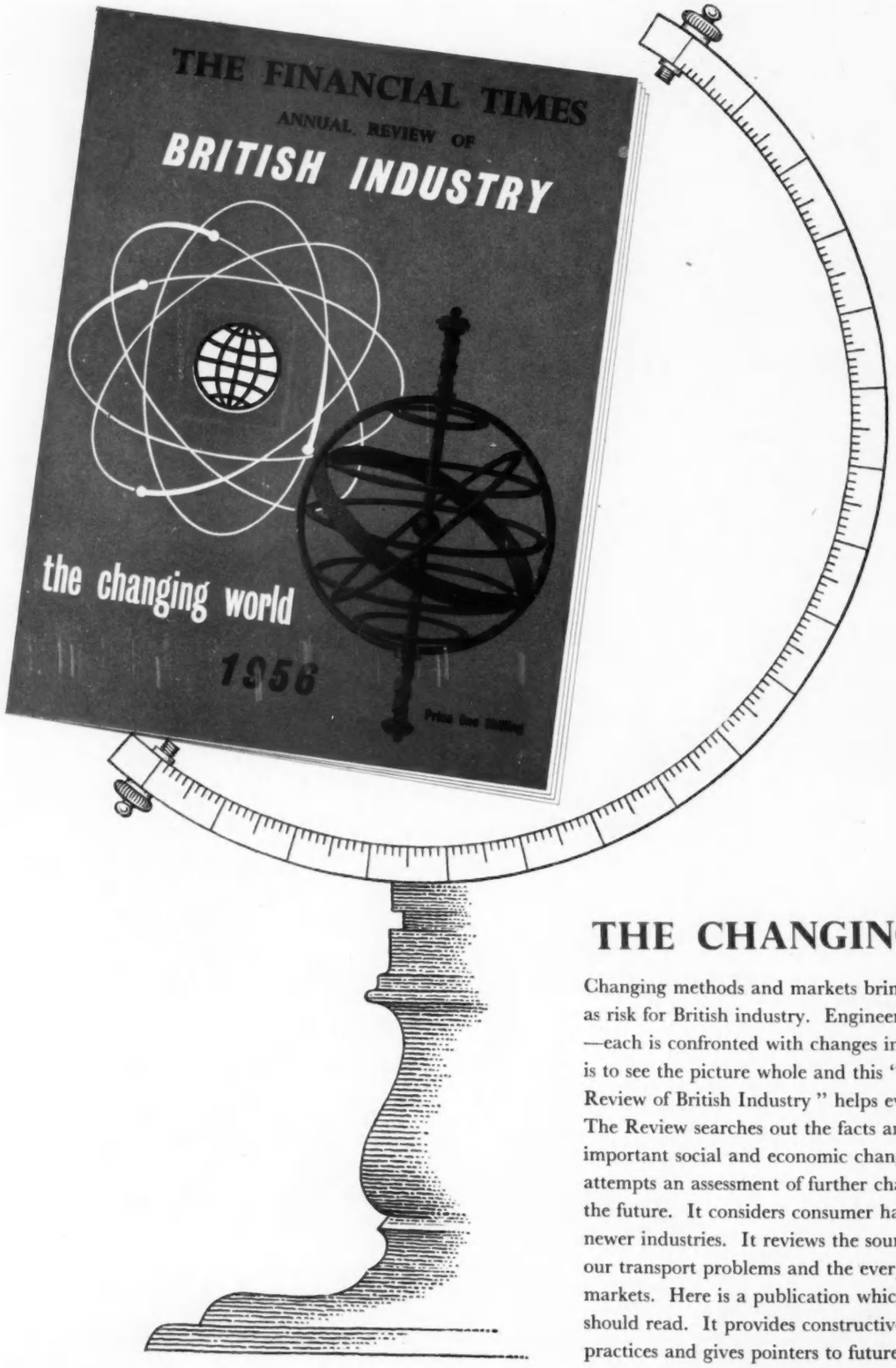
The Company designs and supplies *complete* installations, including the 'Airslide' ducting, Fuller-Kinyon pumps and pipelines for 'pumping' the dry fly-ash from collecting hopper to silo or processing plant, all necessary bunkers, and disposal equipment.

BABCOCK & WILCOX LTD

MATERIALS HANDLING DIVISION
BABCOCK HOUSE, FARRINGDON STREET, LONDON E.C.4

BABCOCK

LOW-PRESSURE PNEUMATIC FLY-ASH HANDLING PLANT



THE CHANGING WORLD

Changing methods and markets bring opportunity as well as risk for British industry. Engineer, businessman, scientist —each is confronted with changes in his sphere. The problem is to see the picture whole and this " The Financial Times Review of British Industry " helps every executive to do. The Review searches out the facts and examines the many important social and economic changes of recent years and attempts an assessment of further changes which are likely in the future. It considers consumer habits and the growth of newer industries. It reviews the sources of our basic power, our transport problems and the ever present problem of overseas markets. Here is a publication which the executive in industry should read. It provides constructive criticism of present practices and gives pointers to future markets.

ON SALE NOW **ONE SHILLING**
FROM NEWSAGENTS EVERYWHERE

THE FINANCIAL TIMES

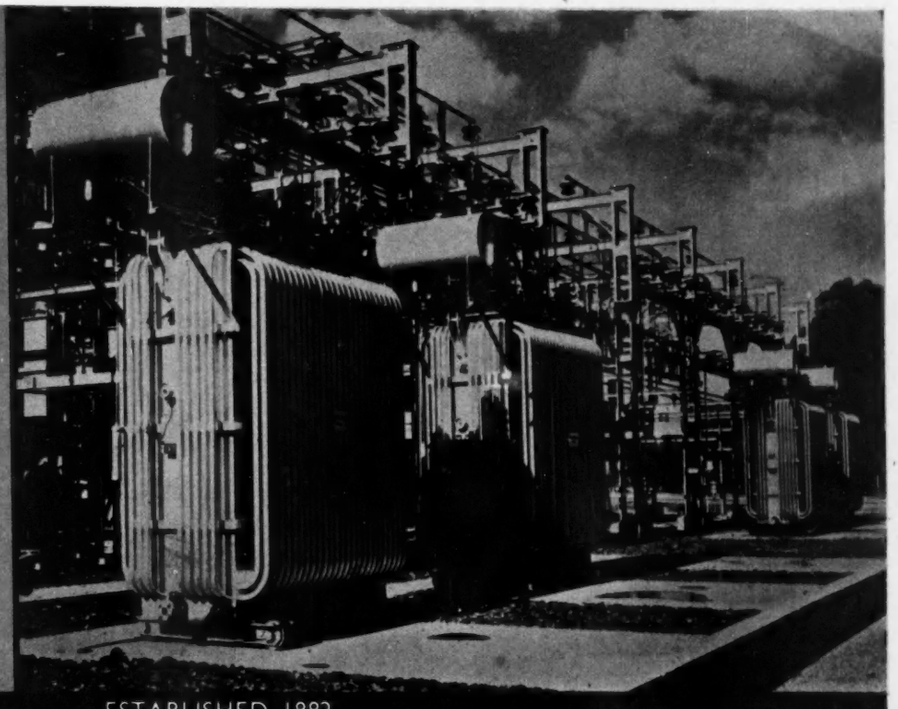
Annual ***REVIEW OF BRITISH INDUSTRY***

TGA 1956

POWER TRANSFORMERS

2000 kVA
33 kV/11910-3420 volts
3 phase transformers
at the Oakdale
Distribution Station of
Cape Town Electricity Supply
Commission

Full range of types in capacities to 15000 kVA at 33 kV and to 10000 kVA at 66 kV.



ESTABLISHED 1882

THE ELECTRIC CONSTRUCTION COMPANY LTD.

TELEGRAMS: ELECTRIC WOLVERHAMPTON

Head Office and Works:
BUSHBURY ENGINEERING WORKS
WOLVERHAMPTON
ENGLAND

TELEPHONE WOLVERHAMPTON 21455 (7 LINES)

2793

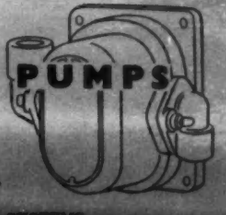
Manufacturers of Rotating Electrical Machinery, Switch and Control Gear, Rectifiers and Transformers.

For compact, flexible, unfailing POWER

Where space is a limiting design factor and the requirement is for a unit which is capable of producing power out of all proportion to its small size—in a great many cases the solution is to install a Plessey High Pressure Hydraulic Pump. Current applications of this pump in heavy duty agricultural and engineering equipment are as varied as they are numerous—and if the day-to-day increase in new users is any guide, there is a wealth of possibility for the Plessey Hydraulic Pump in industry as a whole.

fit **Plessey**

HYDRAULIC PUMPS



Some important applications . . .

BOOK PRESSES · BRAKE SYSTEMS
DIESEL AND GAS TURBINE ENGINES
EARTH MOVING EQUIPMENT
SACKAGE MAKING MACHINES
TRACTORS · CEMENT MIXERS · CRANES
MACHINE TOOLS
INJECTION MOULDING MACHINES

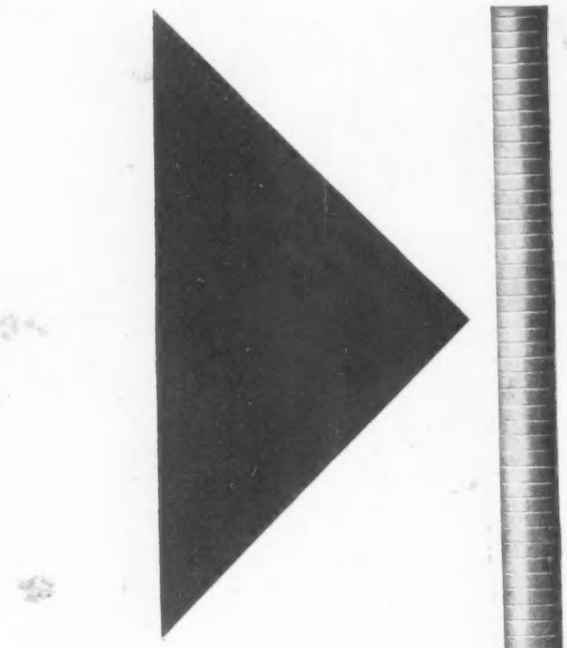
The Plessey Company Limited · Ilford · Essex

HP21

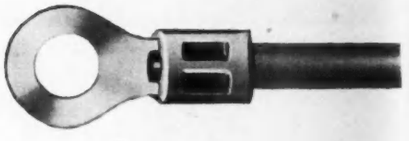
Solderless Terminals and Connections

REDUCE COSTS IN EVERY BRANCH OF INDUSTRY

The AMP method eliminates human error and provides superior wire connections at faster rates of output. Terminals are applied by AMP precision crimping tools or automatic machines to a uniformly high standard of electrical and mechanical efficiency. This method is in widespread use in all parts of the world to reduce assembly costs. Pre-insulated and non-insulated terminals and connectors are supplied for every application.



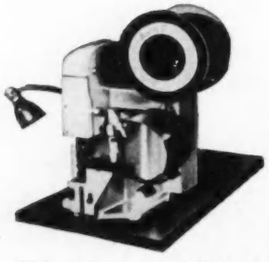
AMP Certi-crimp. Positive closure ensured.



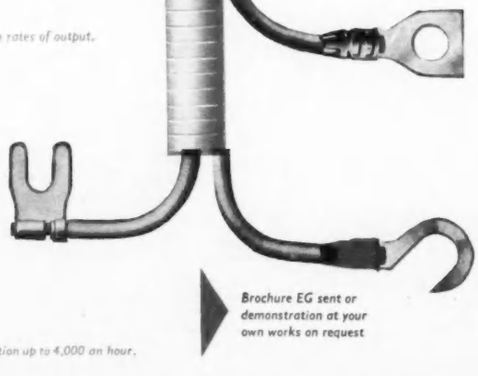
Finished termination — strong, neat, uniform

AMP Pneumatic hand tool. Eliminates operator fatigue. High rates of output.

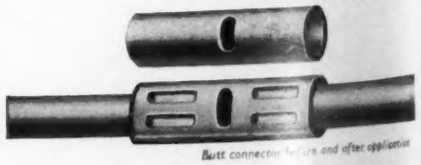
Faston connector



AMP Automatic wire terminator. Uniform, precision installation up to 4,000 an hour.



Brochure EG sent or demonstration at your own works on request



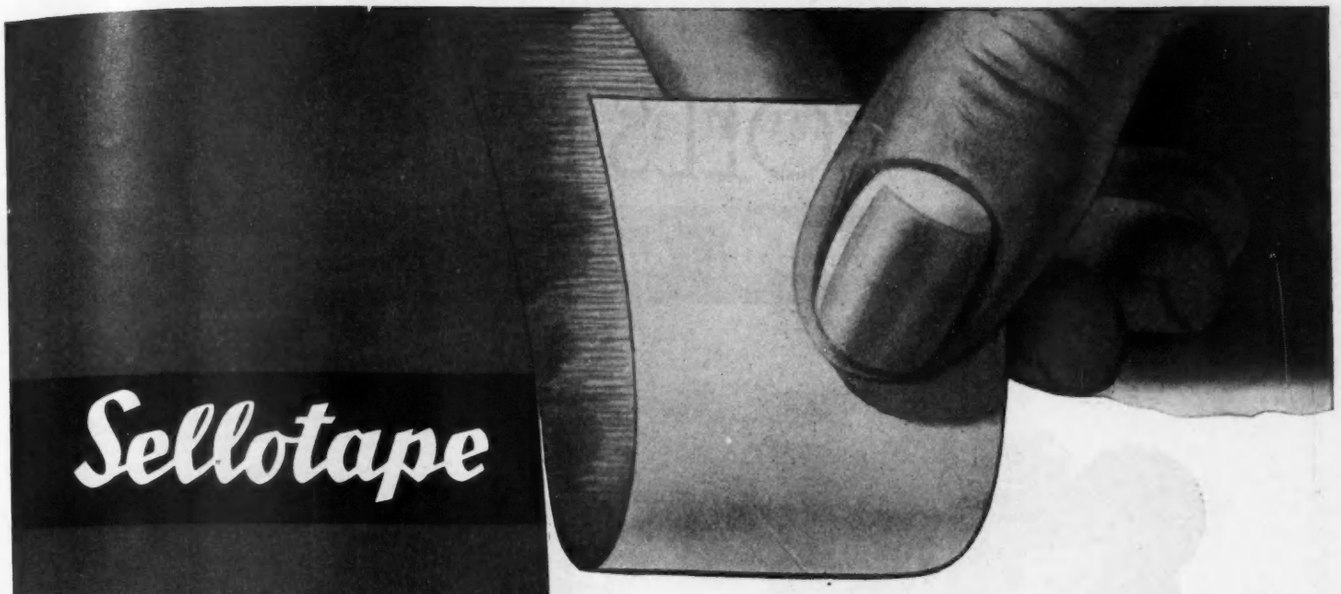
Butt connector before and after application

AIRCRAFT-MARINE PRODUCTS (GT. BRITAIN) LTD

London Sales Office: 60 KINGLY ST., W.1. Tel: REG 2517/8. Works: SCOTTISH INDUSTRIAL ESTATES, PORT GLASGOW, SCOTLAND

Ahead of the present— —abreast of the future

AP323-16



Sellotape

SIX STAR MASKING TAPE

✱ ***Extra Thin***
—gives a sharp, clean outline by eliminating paint build-up.

✱ ***Extra Strong***
—draws straight from the roll without tearing.

✱ ***Resists Penetration***
—entirely unaffected by the heaviest spraying with paint dopes, lacquers, enamels and other liquids.

✱ ***Highly Flexible***
—takes the trickiest contours and corners with ease, without wrinkling.

✱ ***Gently Adhesive***
—sticks at a touch to metal, plastic, glass, wood and rubber—and never curls back.

✱ ***Strips off easily***
—leaves surface completely unaffected after use.

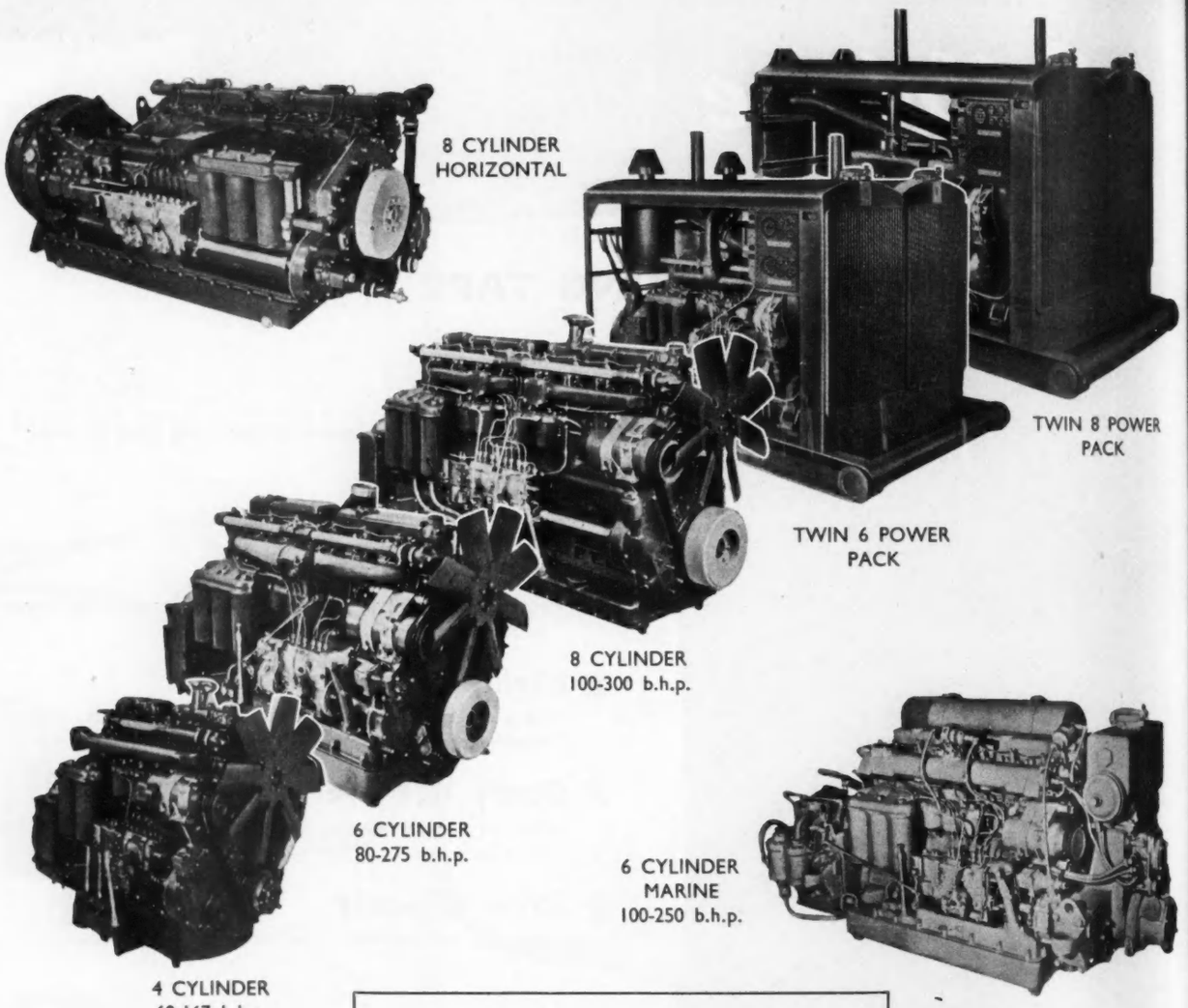
Sellotape
BRAND
masking tape

GORDON & GOTCH LTD
Sellotape Division,
39-40 Farringdon Street, London, E.C.4
CENtral 0531

Sellotape is the Registered Trade Mark of Adhesive Tapes Ltd

ROLLS-ROYCE

OIL ENGINES



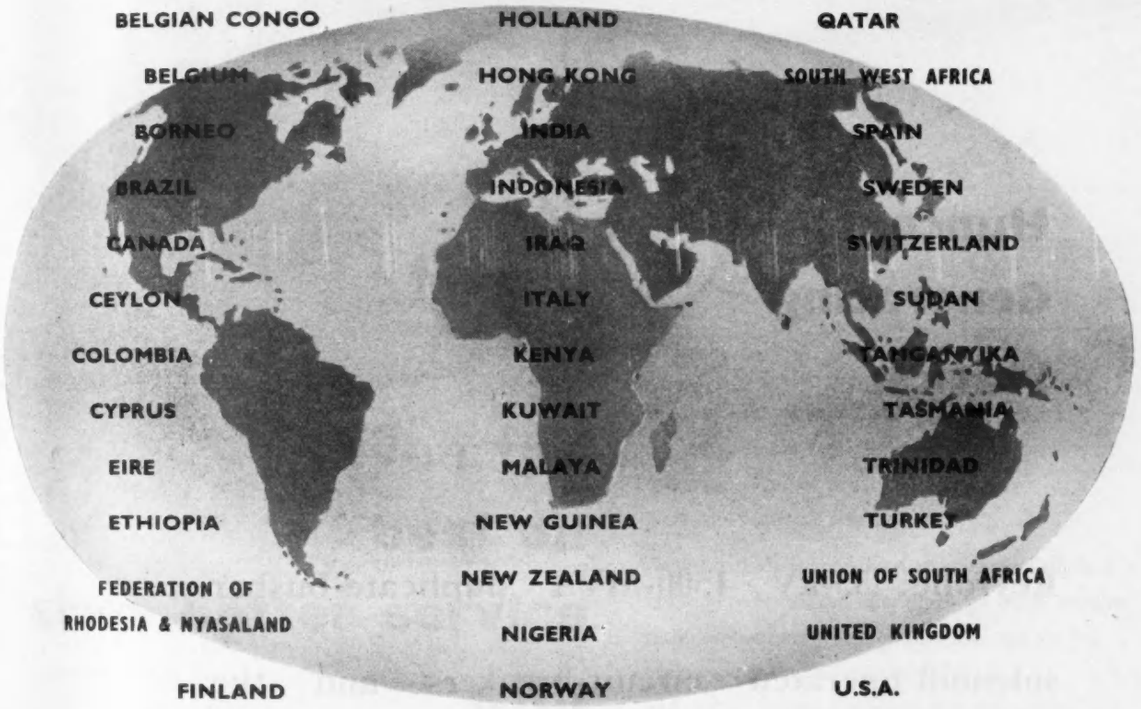
- Common bore and stroke for entire range of four, six, and eight cylinder engines
- Spare parts common to all engines
- Right or left hand build, horizontal or vertical

A range of unsupercharged and supercharged

IN SERVICE FROM THE ARCTIC TO THE ANTIPODES

for Automotive, Industrial, Marine and Railway applications

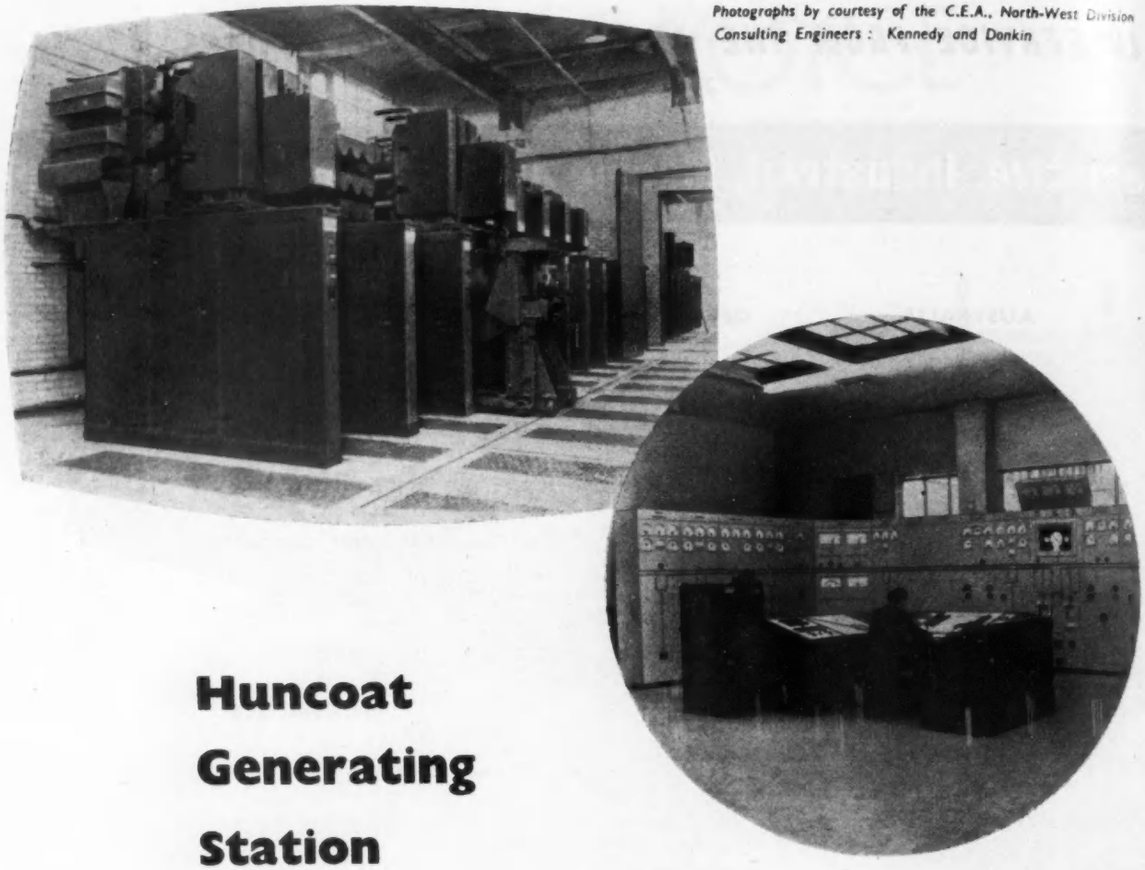
AUSTRALIA
AUSTRIA
BAHREIN
BELGIAN CONGO
BELGIUM
BORNEO
BRAZIL
CANADA
CEYLON
COLOMBIA
CYPRUS
EIRE
ETHIOPIA
FEDERATION OF RHODESIA & NYASALAND
FINLAND
FRANCE
FRENCH WEST AFRICA
GERMANY
GOLD COAST
GREECE
HOLLAND
HONG KONG
INDIA
INDONESIA
IRAQ
ITALY
KENYA
KUWAIT
MALAYA
NEW GUINEA
NEW ZEALAND
NIGERIA
NORWAY
OMAN
PAKISTAN
PERU
PORTUGAL
PORTUGUESE WEST AFRICA
QATAR
SOUTH WEST AFRICA
SPAIN
SWEDEN
SWITZERLAND
SUDAN
TANGANYIKA
TASMANIA
TRINIDAD
TURKEY
UNION OF SOUTH AFRICA
UNITED KINGDOM
U.S.A.
VENEZUELA
YUGOSLAVIA



ROLLS-ROYCE

60-600 b.h.p. OIL ENGINES

ROLLS-ROYCE LIMITED, OIL ENGINE DIVISION, DERBY, ENGLAND



Photographs by courtesy of the C.E.A., North-West Division
Consulting Engineers : Kennedy and Donkin

Huncoat Generating Station

Reyrolle 33-kV 1500-MVA duplicate-busbar solenoid-operated circuit-breakers and the control-room at HUNCOAT Generating Station

Reyrolle

A. REYROLLE & COMPANY LIMITED HEBBURN, COUNTY DURHAM, ENGLAND

even the best oil gives better service with efficient filtration

Effective lubrication depends not only upon good oil, but upon *clean* oil. Contamination — ferrous or otherwise — causes extra wear to moving parts, and increases risk of breakdown.

Philips with their specialised experience of efficient filtration methods, can offer filters for diesel engines, turbines, machine tool coolants . . . in fact almost every type of fuel, lubrication, hydraulic and coolant system. Technical staff will gladly advise on the best filter for the job and, if necessary, standard equipment can be adapted to suit individual requirements.

A comprehensive brochure covering the wide range of Philips filtration equipment is available on request. Write for your copy today.

Filtration Department

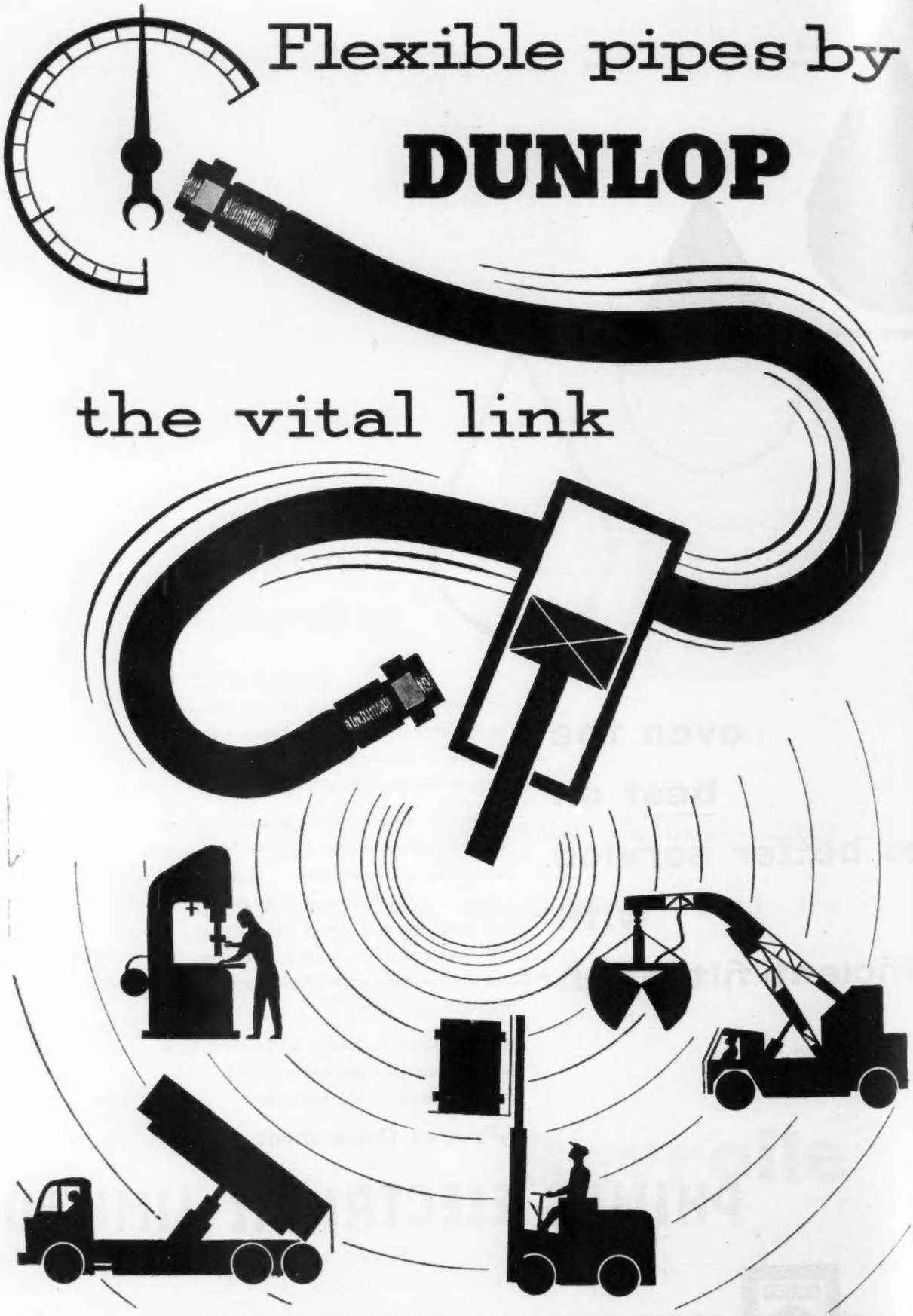
PHILIPS ELECTRICAL LIMITED

PHILIPS

INDUSTRIAL PRODUCTS DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · WC2

(P101B0)

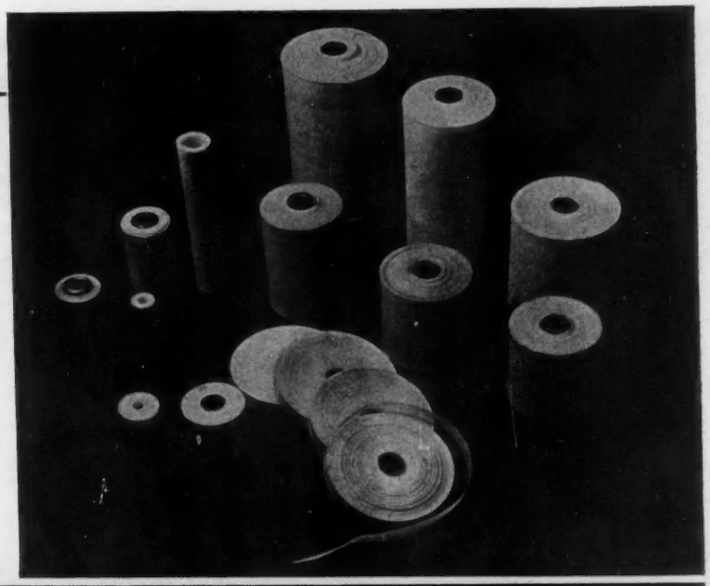
Flexible pipes by DUNLOP



the vital link

Dunlop technicians will always advise on any problems concerning installation of flexible piping. Write please to:—

DUNLOP RUBBER COMPANY LIMITED · ST. GEORGE'S ROAD · COVENTRY · TELEPHONE: COVENTRY 64171



The Petroleum Industry and

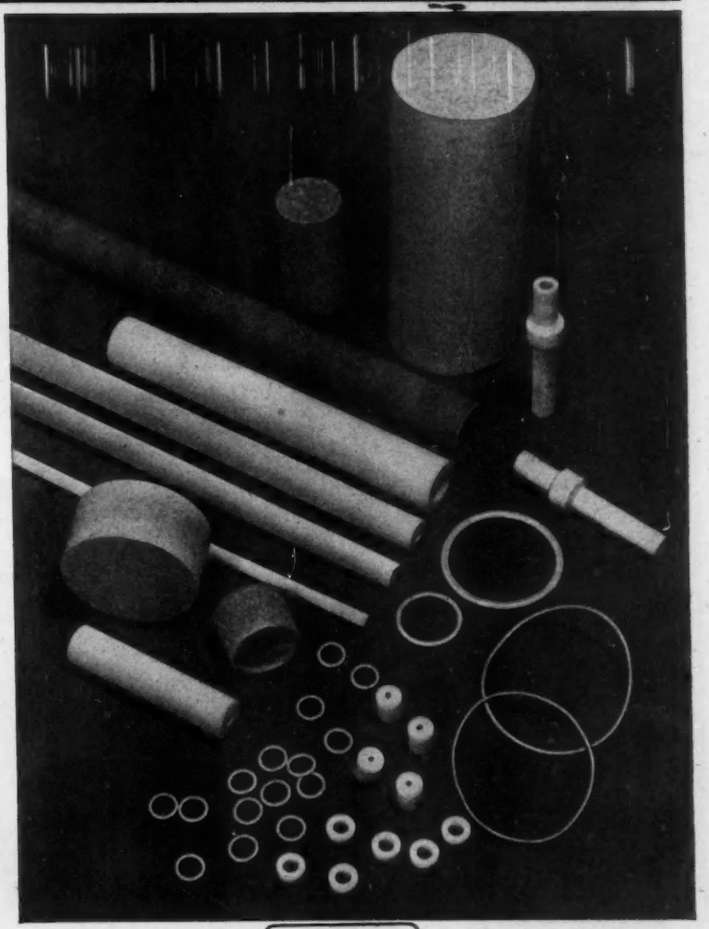
Polytetrafluoroethylene (PTFE)

This Company began experimenting with PTFE when it was first introduced into this country. Shortly afterwards we started processing and fabricating the material in a special division of our own factory, giving our own designation of CF2 (derived from the formula) to the range of products ultimately produced.

Since that time, our experience, both of the behaviour of the material itself, during processing, and the application of its remarkable properties has been accumulating.

We have developed techniques, and we have designed special equipment with which to apply them, so that we now mould, fabricate, and otherwise fashion PTFE from its basic forms, i.e. rounds, discs, flat mouldings, rings, cylinders, rods, tubes, tape and cord, as illustrated, into innumerable components which are already widely used by the petroleum and allied chemical industries. The material is unique inasmuch as it is far more corrosion-resistant than either gold or platinum; it is unaffected by any known solvent; it is self-lubricating, and it is non-adhesive, to mention but a few of the more important properties.

It is obviously impossible for a material of this kind to attain its full usefulness to any industry without research and experimental work. We have set aside a substantial part of our resources for this purpose, and will willingly co-operate to the fullest extent of these resources with any Company desiring to make use of the material. By arrangement we will make available facilities for practical development work to be carried on.



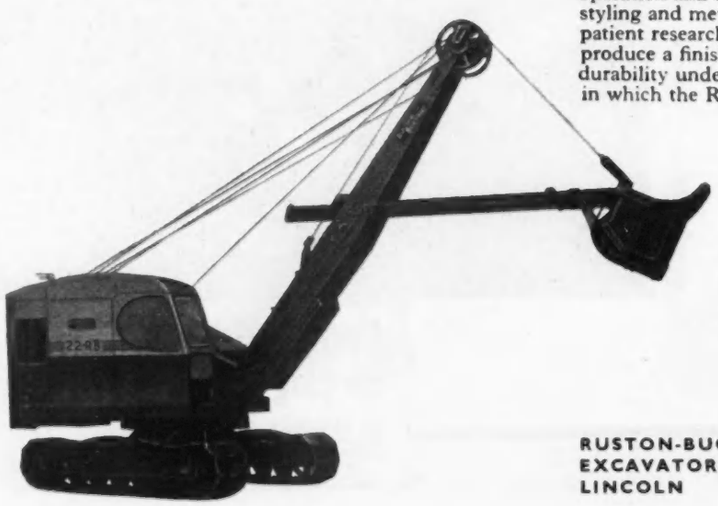
The following Information Bulletins are now available: No. 4, BASIC PROCESSING AND PROPERTIES, *and No.* 5, APPLICATIONS. *Both publications will be sent on request to interested engineers.*

Crane Packing LTD OF SLOUGH ENGLAND
A Crane Company

Improvements represented by attention to detail, are continually being built into Ruston-Bucyrus excavators.
The process of development is a never ending one and as improvements are developed so are they incorporated in the complete range of Ruston-Bucyrus excavators up to 6 cu. yds. capacity.

A PROGRESSIVE POLICY OF DEVELOPMENT

R-B excavators in certain sizes are now being built with a re-designed cab in a new and attractive colour scheme, but neither design nor colour scheme has been introduced merely for the sake of change. Both in fact are the result of the policy of development in detail for the customer's benefit.
The new design is devised to increase ease of operation and to give greater visibility. The new colour styling and metal pre-treatment proclaim a long period of patient research into the problems of metal preservation to produce a finish that will give an even higher degree of durability under the severe and exacting conditions in which the R-B excavator is normally expected to work.



Replacement of your existing equipment can, therefore, be considered at any stage with complete confidence that a new R-B excavator will, in one direction or another, represent an improvement upon existing equipment.

RUSTON-BUCYRUS LIMITED
EXCAVATOR SPECIALISTS
LINCOLN

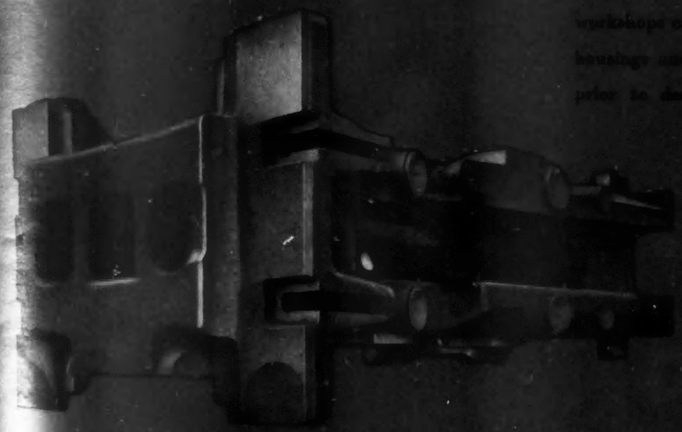
RUSTON-BUCYRUS

BEARDMORE

STEEL CASTINGS

The production of forgings and castings to the large sizes demanded by present day engineering, requires machine and erection shops completely equipped to meet this need. Beardmores have extensive workshops capable of manufacturing and handling such items as roll housings and a complete rolling mill can be erected for inspection prior to despatch, a service that only a few makers can give.

The illustration shows a cast steel work roll housing during and after machining. It measures 15' 3" x 11' 6" x 5' 0" and weighed 75 tons 5 cwt. in the condition shown.



PRODUCTS AND SERVICES

Forgings and Castings up to 170 tons in Carbon and Alloy steels; Rotor Shafts; Rolling Mill Plant; Railway Castings and Forgings; Axles; Marine General Engineering Plant; dimensional and complete machining facilities.

WILLIAM BEARDMORE & CO. LIMITED

Parkhead Steel Works, Glasgow, E.1.

Telephone: SHIDCETON 2681-3 Telegrams: BEARDMORE, Glasgow.

London Office: 4 St. James's Square, S.W.1. Tel.: Whitehall 6645.

Manchester Office: 8 St. John St., MANCHESTER, 3. Telephone: Blackfriars 9745

Service to Industry

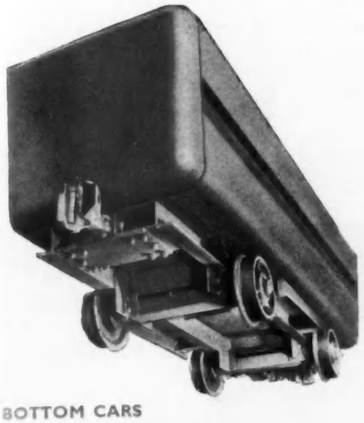
The Regent Oil Company, through its Technical Staff, is at the service of Industry to advise on the efficient lubrication of your plant and machinery.

Photographs by courtesy of Firestone Tyre and Rubber Co. Ltd.

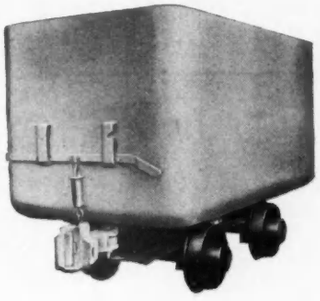
REGENT OIL COMPANY LTD

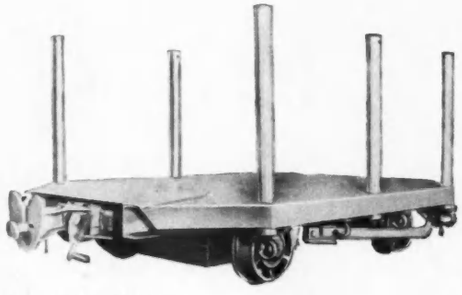
Distributors of Caltex Lubricants in the United Kingdom.

REGENT | CALTEX



SOLID BOTTOM CARS





FLAT DECK CAR

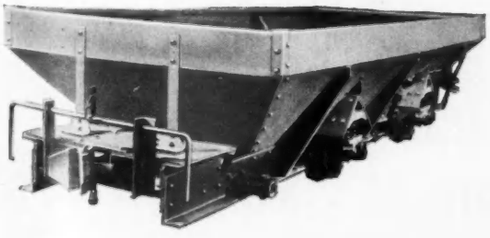
DISTINGTON

LIGHT RAILWAY VEHICLES

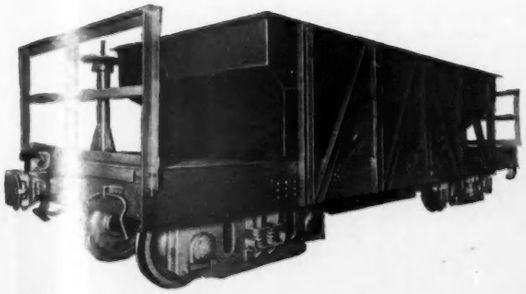
Most Distington cars are made by flow production methods which include the extensive use of jigs; their components are therefore interchangeable; re-assembly of the cars is straightforward after they have been exported in 'knocked down' form. Cars required in small quantities, are built individually.

Distington Engineering Company's staff responsible for the design of light railway vehicles, make the best compromises between the saving of weight on the one hand and stiffness, strength and low maintenance expenditure on the other. M.T.K. medium tensile, corrosion and abrasion-resisting steel is frequently used for making Distington mine car bodies. This steel offers a saving in weight or a gain in strength compared with ordinary mild steel.

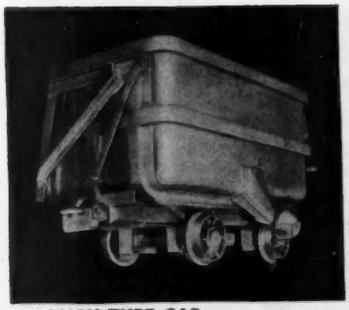
DISTINGTON ENGINEERING COMPANY LIMITED · WORKINGTON · CUMBERLAND · ENGLAND

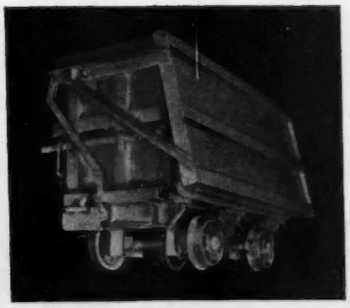


AUTOMATIC DROP-BOTTOM CAR

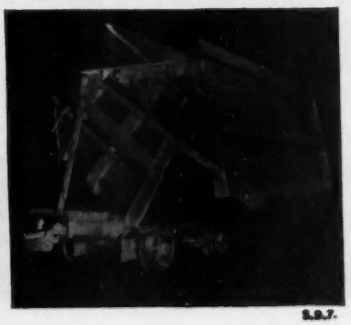


BOTTOM DUMP CAR

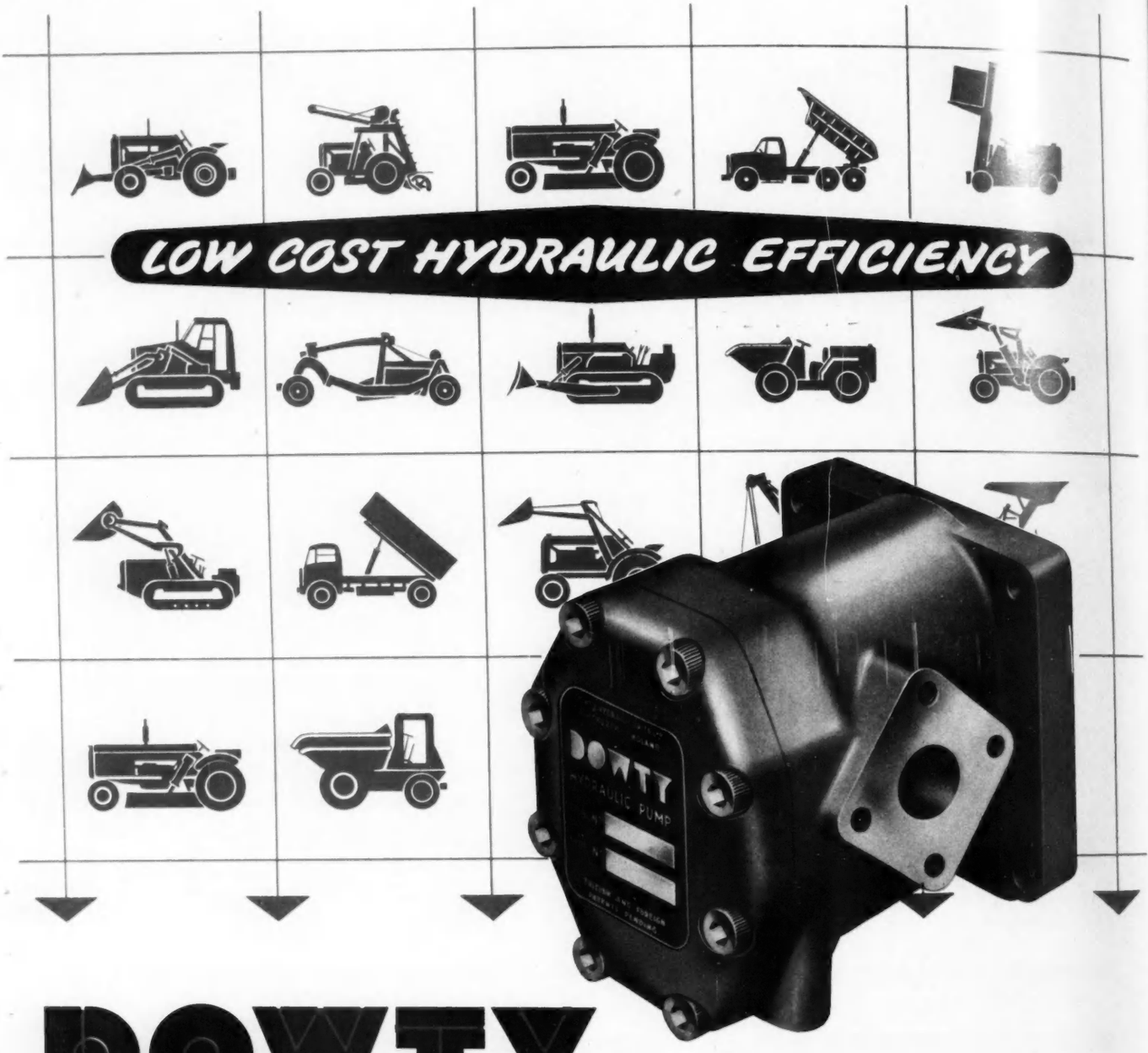




GRANBY TYPE CAR



S.B.J.



DOWTY *hydraulic* PUMPS

★ 1 to 50 G.P.M.
★ HIGH PERFORMANCE
★ SIMPLE CONSTRUCTION
★ PROMPT DELIVERY
★ LOW COST

PUMPS · CONTROL VALVES · RAMS · COUPLINGS

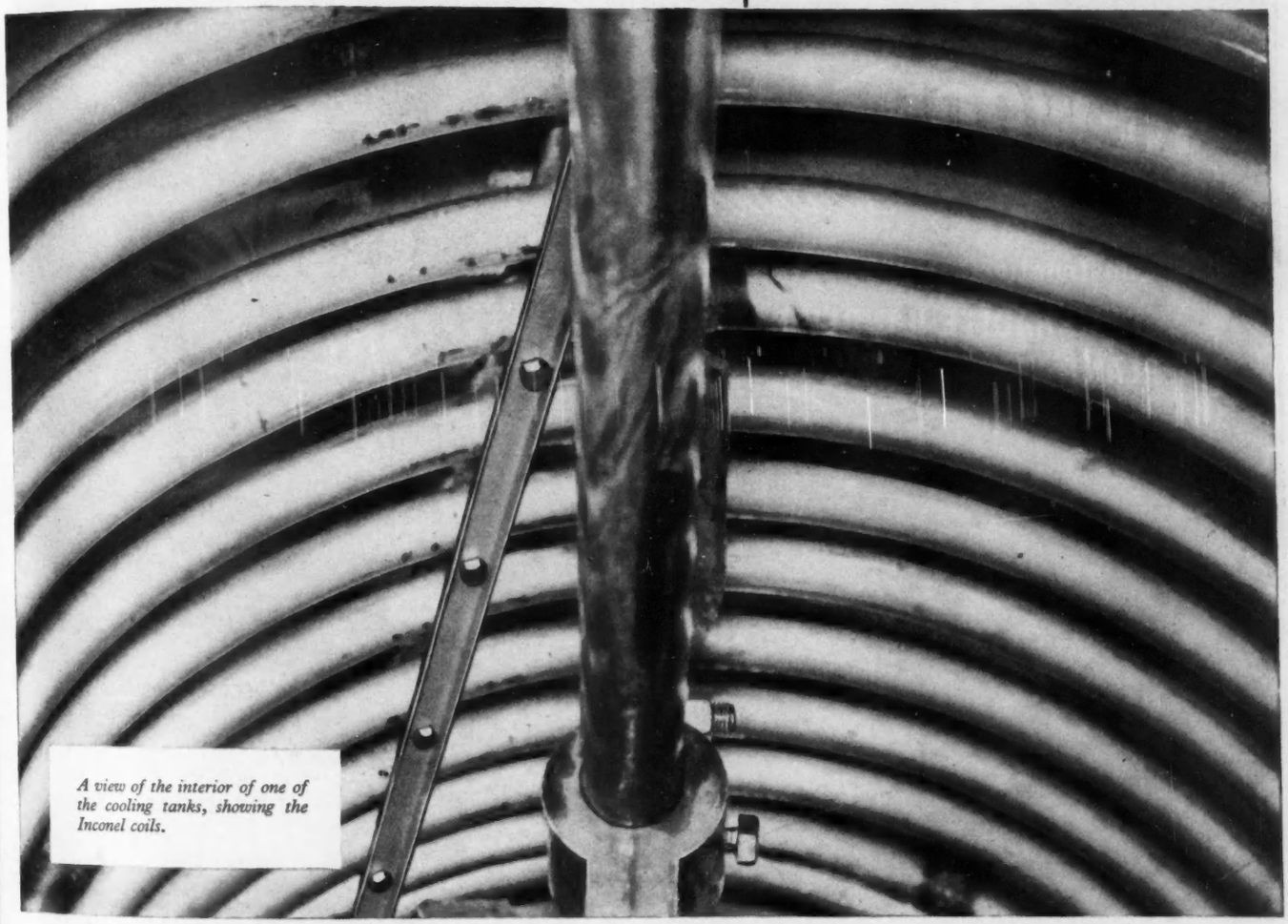
Illustrated literature available on request

DOWTY HYDRAULIC UNITS LTD · ASHCHURCH · GLOS

Member of the DOWTY Group

TO COUNTER CORROSION

Now they're using INCONEL



A view of the interior of one of the cooling tanks, showing the Inconel coils.

Clyde Oil Extraction Ltd. of Glasgow are refiners of edible oils, and commence with bases such as maize seed, soya beans and palm kernels. During the final stages of refining it is necessary to cool the purified oil from temperatures of around 150°C, and cooling vessels using Clyde river water are used. The coolant is fed under pressure through the coils in the vessels and the hot oil is maintained under vacuum to retard oxidation; the oil is agitated until its temperature falls to 50°C, when the vacuum is released. Oils refined at this plant are ultimately used for the manufacture of margarine and cooking fats.

In the region of the Clyde Oil plant the water contains numerous impurities, some of which are exceptionally corrosive. The cooling coils, therefore, have to be constructed of a material resistant to attack by a wide range of corrosive substances found in the cooling water, and to possible attack on the outside by the refined oils at temperatures of up to 150°C.

Inconel, a nickel-chromium-iron alloy has a high degree of resistance to corrosion under operating conditions such as those at Clyde Oil, and was therefore the material chosen for the cooling coils. Each coil was fabricated in 8 sections from 2 in. bore 16-gauge tubing using normal oxy-acetylene welding procedures.

This application is typical of the many ways in which Inconel and other Wiggin corrosion-resistant alloys are increasing efficiency in industrial processes which involve severe temperature and corrosive conditions.

OUR TECHNICAL SERVICE
is available to assist those with problems involving corrosion or high temperatures.

'INCONEL' is a Registered Trade Mark

HENRY WIGGIN & COMPANY LIMITED *WIGGIN STREET · BIRMINGHAM 16*

YGA CB8

I

NEWCON

serving industry

under construction for NCB South-West Division

PHURNACITE HANDLING PLANT AT ABERAMAN

comprising:

SCREEN HOUSES AND EQUIPMENT
CONVEYING SYSTEM
BATTERY CONVEYORS
WHARF CONVEYORS
SHUTTLE CONVEYORS

PHOTOGRAPH BY COURTESY OF N.C.B. S.W. DIVISION

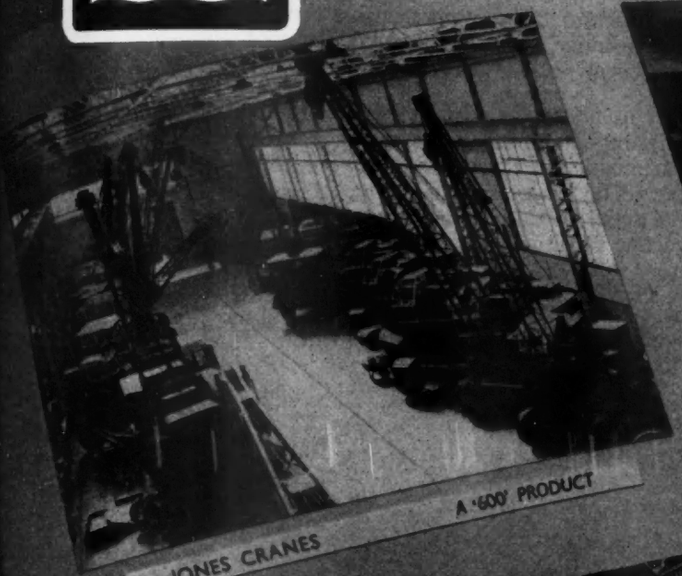
A TI Company

NEW CONVEYOR CO LTD

HEAD OFFICE SMETHWICK BIRMINGHAM TEL. SMETHWICK 1964 ALSO AT MANCHESTER GLASGOW LONDON

THE 600 GROUP OF COMPANIES

Some Products & Services



JONES CRANES A '600' PRODUCT

DISMANTLING A '600' SERVICE

FRAMEMESH REINFORCEMENT A 600 PRODUCT

CONTRACTORS' PLANT HIRE A '600' SERVICE

GEORGE COHEN SONS AND COMPANY LIMITED

Established in the year 1834

Associated Companies :— T. C. Jones & Co. Ltd · K & L Steelfounders & Engineers Ltd · Metalclad Ltd · Jones Cranes Ltd (Canada) · Pollock, Brown & Co. Ltd · The New London Electron Works Ltd · Six Hundred Ltd · Westbourne Park Coal & Iron Co. Ltd · The Colchester Lathe Co. Ltd · Southall & Hayes Coal & Iron Co. Ltd · George Cohen Sinteel Ltd · L. Gamet Products Ltd · Western Metallurgical Industries Ltd · The Colchester Lathe Co. (Canada) Ltd · Henry Osman & Co. Ltd · The Selson Machine Tool Co. Ltd · E. H. Hewitt Ltd

The 600 Group Information Department is located at Wood Lane, London, W.12. Telephone: Shepherd's Bush 2468. Telegrams: Gohen, London.

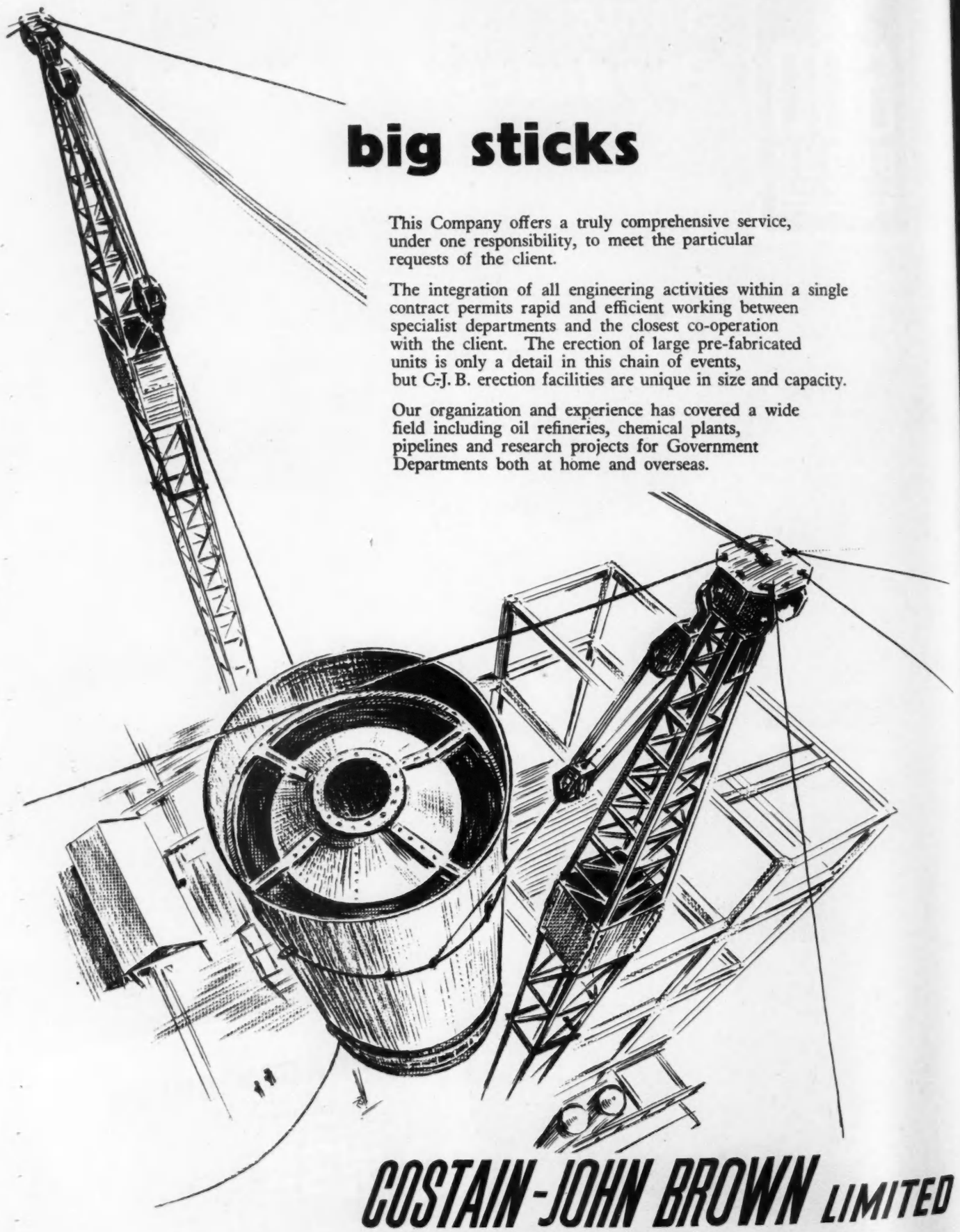
Number One of a Series

big sticks

This Company offers a truly comprehensive service, under one responsibility, to meet the particular requests of the client.

The integration of all engineering activities within a single contract permits rapid and efficient working between specialist departments and the closest co-operation with the client. The erection of large pre-fabricated units is only a detail in this chain of events, but C-J. B. erection facilities are unique in size and capacity.

Our organization and experience has covered a wide field including oil refineries, chemical plants, pipelines and research projects for Government Departments both at home and overseas.

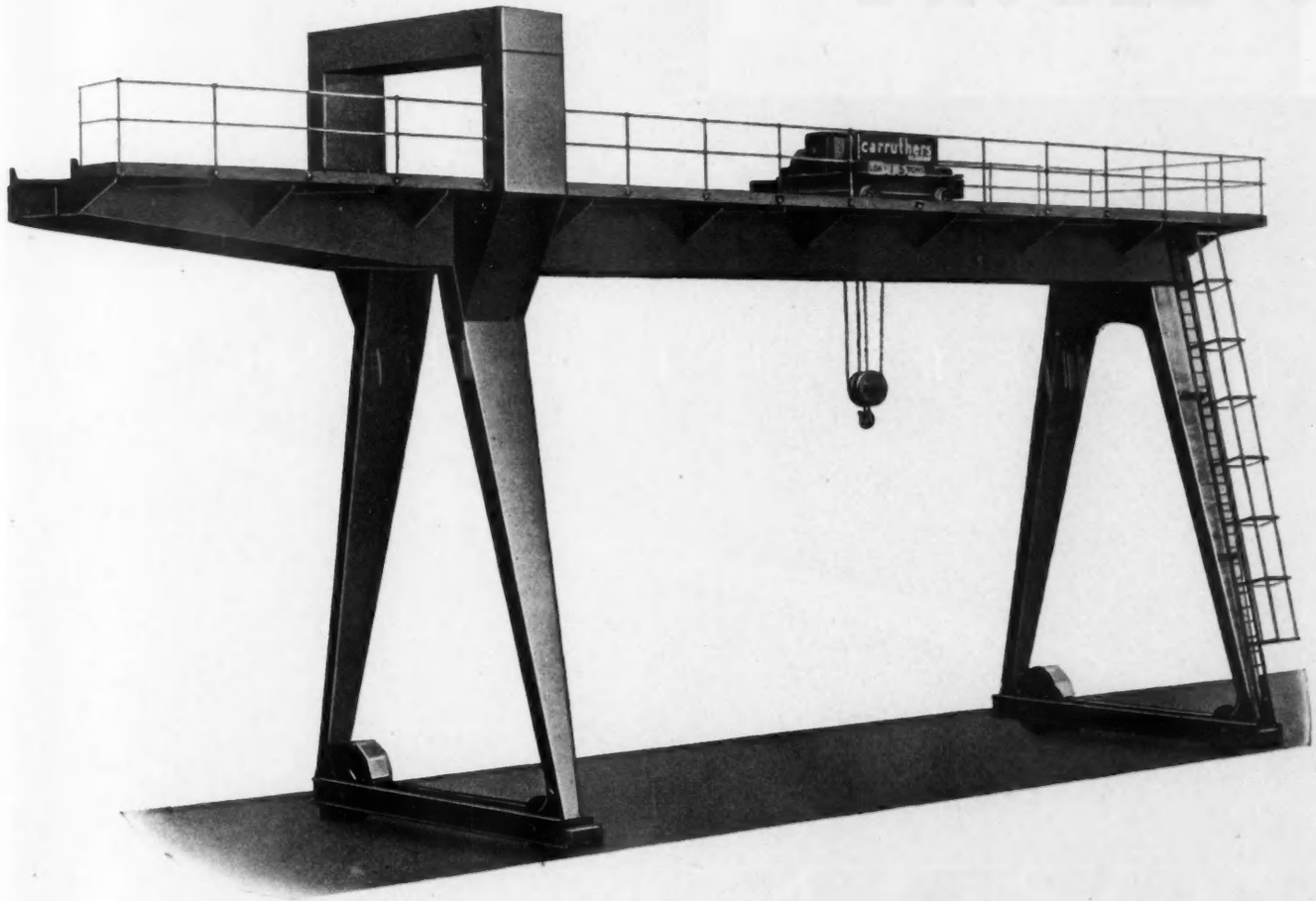


COSTAIN-JOHN BROWN LIMITED

73 SOUTH AUDLEY ST., LONDON W.1.

Phone: GROSVENOR 4181 & 8331. Cables: CIVANIC, LONDON.

GOLIATH
OVERHEAD TRAVELLING GANTRY
CRANES

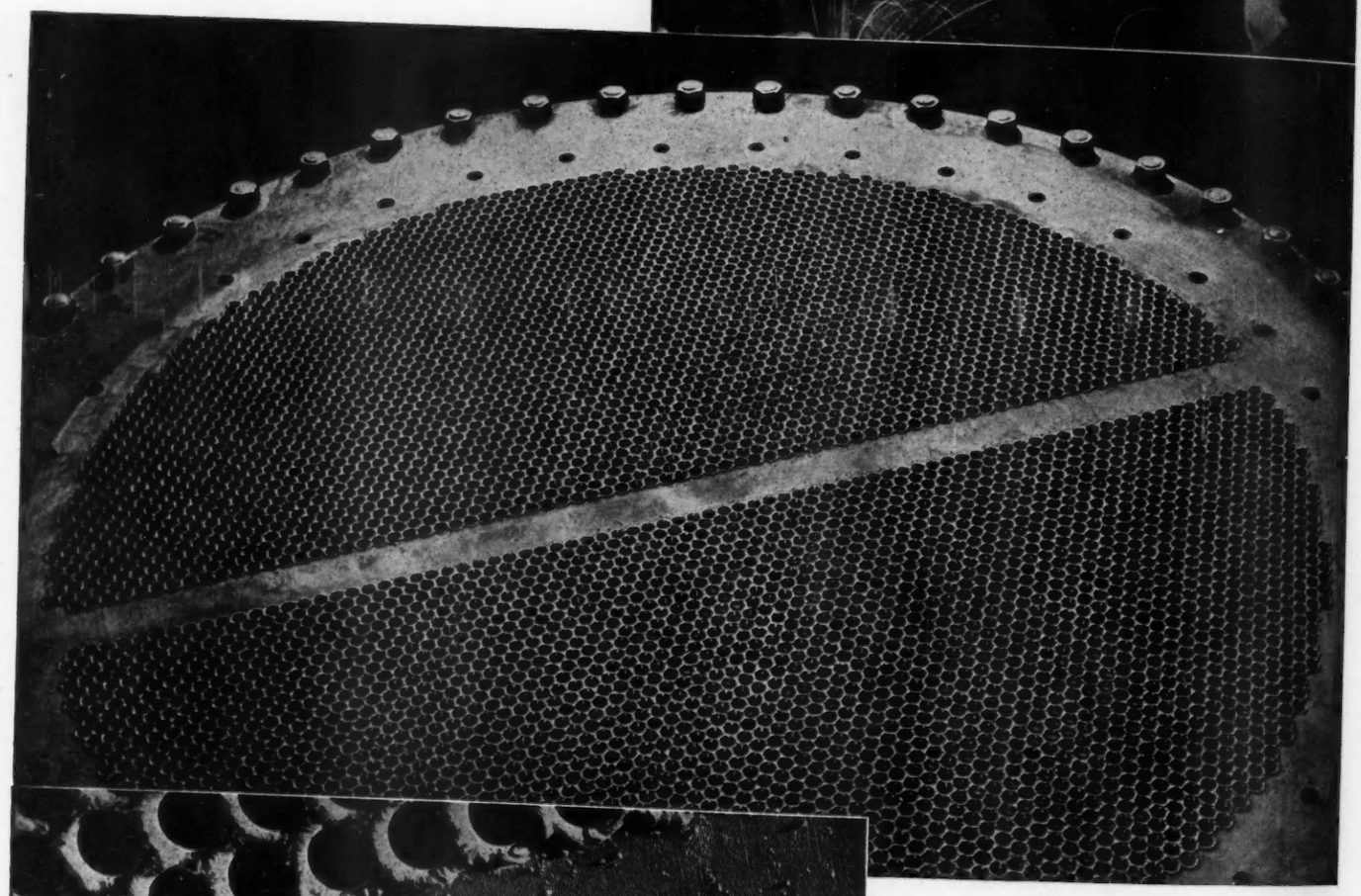


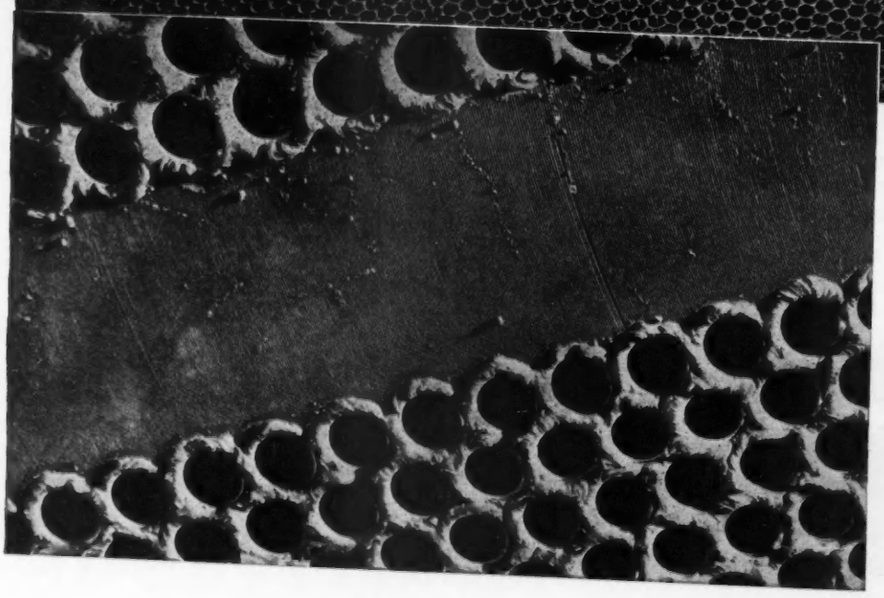
A typical medium capacity "Goliath Crane" supplied recently to an electricity authority.

carruthers

J. H. CARRUTHERS & COMPANY LTD., GLASGOW, S.2
LONDON OFFICE: ABFORD HOUSE, WILTON ROAD, VICTORIA, S.W.1

Dexterity in WELDING



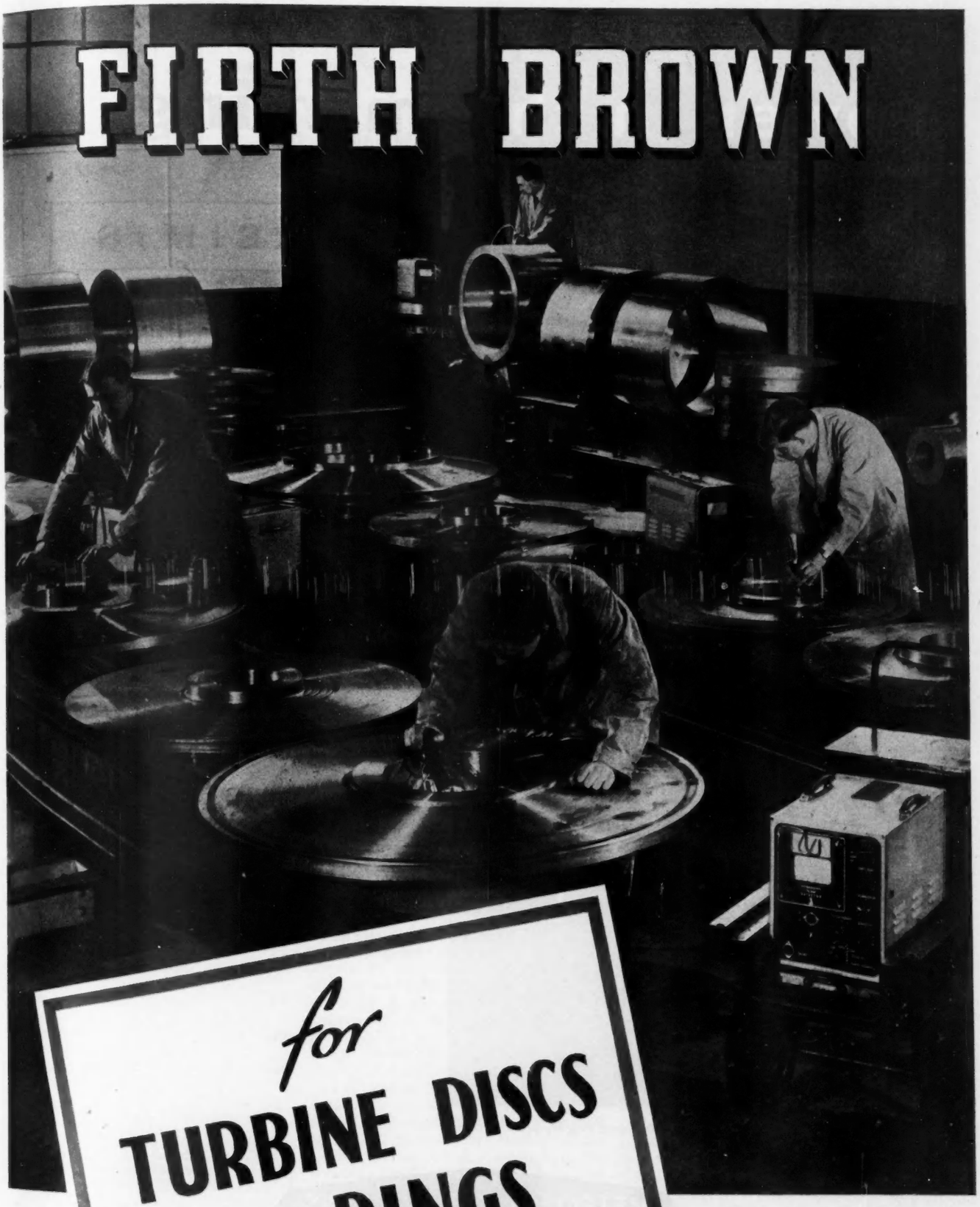


Tube plate for a Heat Exchanger, incorporating 5518 tubes ¾ in. dia., and involving 1078 footage of welding.

Harvey

G. A. HARVEY & CO. (LONDON) LTD
Woolwich Road · London, S.E.7
Telephone: GREenwich 3232 (22 lines)

FIRTH BROWN



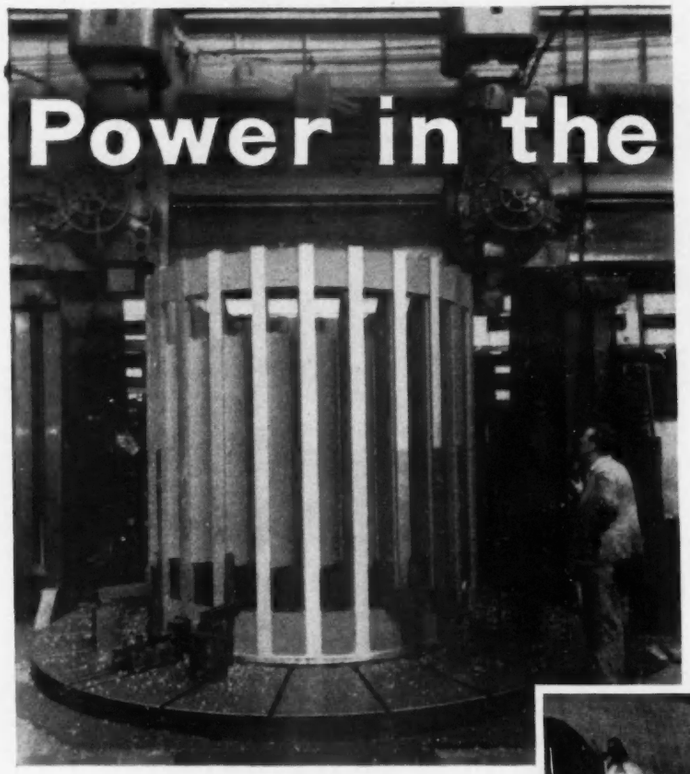
for

TURBINE DISCS AND RINGS

Ultrasonic Testing and Magnetic Crack Detection of Turbine Discs and Rings.

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

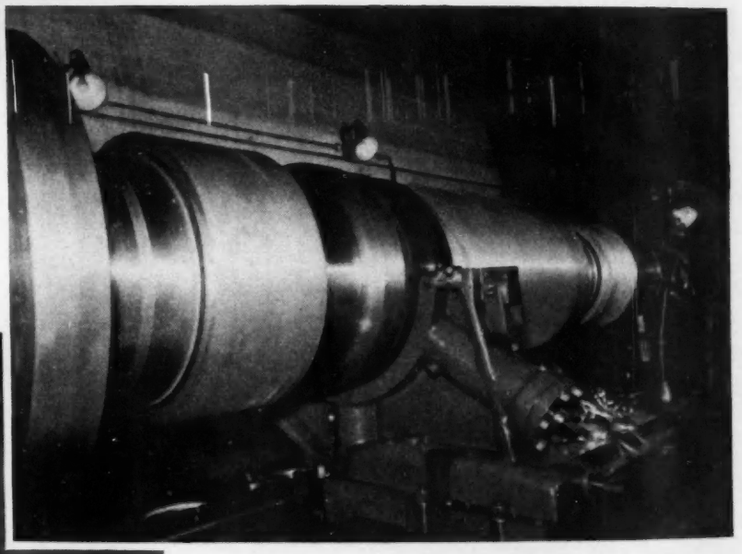
Power in the making...



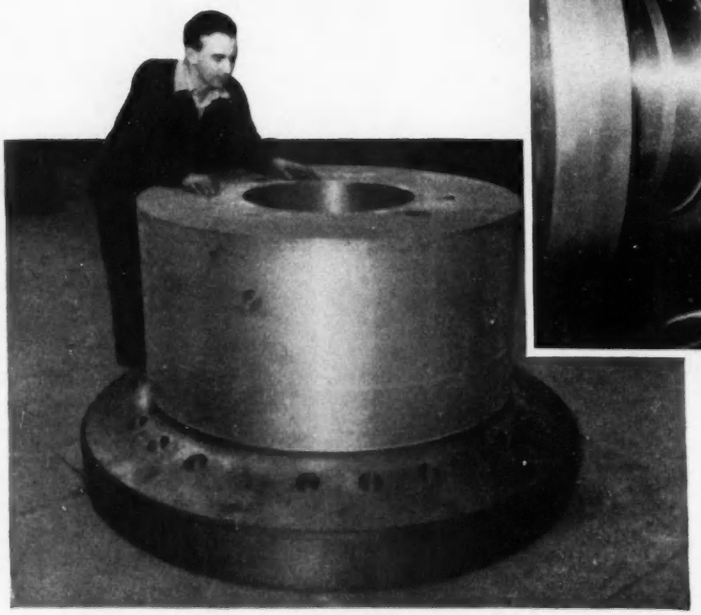
BERSIMIS

Vertical water wheel generators of larger capacity than any hitherto constructed are being built by Metropolitan-Vickers for the Bersimis Lac Casse development of the Quebec Hydro-Electric Commission. Four generators will be supplied, each having an output of 138 MW at 277 r.p.m. These photographs illustrate some of the work in progress.

Machining the rotor spider



Machining the rotor shaft. The completed rotor will weigh 300 tons.



The thrust block which will carry 360 tons dead weight, and 190 tons of water thrust.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

Member of the AEI group of companies.

Leading Electrical Progress

C/A502

ENGINEERING

An Illustrated Weekly Journal

Vol. 181 No. 4709 JUNE 8, 1956

Leading Article

Jet Engines 449

Plain Words 450

Weekly Survey 453

Principal Articles

Engineering in Egypt: Changes and Trends since the Revolution 450
The Problem of Sway in Moment Distribution: General Treatment Using Concept of Virtual Work 457
Institution of Naval Architects Spring Meeting: Hull Resistance of Harbour Craft 459
Engineering in Scotland—I 461
The Iron and Steel Institute Spring Meeting: Acid-Bessemer Process, Ingot Heating and Solidification 463
Electromagnetic Pilot Valve 465
Research on Surface Coatings, Detergents and Plastics: A Laboratory to Help Users 465
New Permanent Magnet Materials 466
A Gas Turbine in Series Production: Batch Test Facilities for a Versatile Engine 469
Conveyor Belt Idler: Neoprene Rollers on a Flexible Support 471
Transmission with Automatic Gear Change: Planetary System having Hydraulic Control 472
Tubular Staging with Quick Locking Connections 473
Harwell Review 474
Pre-Cast Concrete Warehouses 476
Setting a Work-table Quickly: Electromagnetic System with Alternative Punched-Card or Manual Control 477

Letters to the Editor

Passenger Movement: Conveyor Belt System in 1904 452

Book Reviews

Principles of Nuclear Reactor Engineering 467
Plant Maintenance in Practice 467

New Books and Trade Publications 468

Notes

A Record in Electrical Generation 466
Corrosion at Bimetallic Contacts 475
Productivity in Hot-Dip Galvanising 475

Notices of Meetings 477

In Parliament 479

The Human Element 480

★ ★ ★

Published every Friday by Engineering Limited 35 & 36 Bedford Street, Strand, London, W.C.2
TELEGRAPHIC ADDRESS *Engineering, Lesquare, London* TELEPHONE *Temple Bar* 3663

★ ★ ★

Subscription Rates for 12 *months, Inland and Abroad* £5 5s., *Canada* £5 5s. *Subscriptions for periods of less than* 12 *months are based on the price of a single copy including postage* (2s. 3d.)

JET ENGINES

Now that the Vickers 1000 has dropped out of the competition for the big jet air-liners which will be used in the early 1960's, Britain's main interest in this particular generation of aircraft has shifted to the possibility of supplying engines for American airframes. For a long time, there had been rumours of discussions on the use of the Rolls-Royce Conway by-pass engine and the Bristol Olympus pure jet engine, and the recent order by Trans-Canada Air Lines for Douglas DC 8 aircraft equipped with Conways is very welcome indeed. Not only does it represent a valuable dollar order in itself, but it is likely to have much wider repercussions; it will not only establish a very important precedent for the use of British engines in the aircraft concerned, but also provide the first production application of the by-pass type of jet engine.

The idea on which this engine is based originated with Sir Frank Whittle as long ago as 1936. Owing to the necessity to concentrate on the basic development of the jet engine as such, the by-pass engine was neglected, although there was some half-hearted attempts to build various forms of "ducted fan" or "thrust augmentor" engines. The reasons for this neglect were good in the circumstances (as was recognised by the High Court in 1951 in granting the maximum possible extension of ten years to the original Whittle patent). But the advent of large, long range civil and military aircraft, flying at speeds beyond that for efficient propeller operation, has provided the incentive for development of this type of engine, now exemplified by the Conway. The by-pass concept represents an attempt to overcome what has been the main disadvantage of the pure jet engine at speeds now considered low or moderate, namely, high jet velocity with resultant low propulsive efficiency and high fuel consumption. At speeds up to 400 m.p.h. the answer lies, undoubtedly, in the use of the propeller. However, this becomes less attractive at speeds beyond 450 m.p.h. because of the propeller's Mach number difficulties.

In the next speed range, the by-pass engine is generally assumed to have a small, but definite, advantage in efficiency over the pure jet engine. Since the long-range passenger aircraft business is highly competitive, this advantage can be very important. Moreover, the by-pass engine gives a better take-off performance than the pure jet engine, and this is an important feature when one appreciates the length of runway which is required by the new Douglas and Boeing aircraft. Last, but not least, the by-pass engine is quieter than the equivalent pure jet, because noise is proportional to jet velocity to a power of 8 or 9 and the by-pass engine has a lower jet velocity. Bristol Engines, Limited, have recently stated the specific advantages of the pure jet engine (ENGINEERING, June 1).

Looking beyond the immediate future, everything depends on how quickly passenger aircraft speeds rise, and on general gas-turbine development. Increasing aircraft speeds will favour the pure jet engine, but forseeable engine developments are more likely to favour the by-pass engine. On the one hand, the pure jet engine enjoys a relative increase in propulsive efficiency with increasing speed, other factors remaining constant; on the other hand, the by-pass engine gains more from increases of the permissible turbine inlet temperature. It is true that higher temperature increases the thrust of a pure jet engine, but it also increases its specific fuel consumption, because the higher jet velocity reduces the propulsive efficiency. The next major step in gas-turbine development will probably be the large scale introduction of turbine cooling, which will allow the turbine inlet temperatures to be raised appreciably.

Another factor, which might influence the choice between by-pass and pure jet engine, could be the successful application of the jet-flap pioneered by the National Gas Turbine Establishment. This device for increasing, very substantially, the lift of aerofoils requires a mass of air, having a comparatively low jet velocity, ejected at or over the trailing edge of the wing. A by-pass engine is the most obvious means of providing the large flows desirable and, in addition, the by-pass engine's exhaust, being appreciably cooler, enables the jet flap principle to be much more easily applied. The protagonists of the jet flap would like to see the development of an engine with a by-pass ratio considerably in excess of that of the Conway.

A developed by-pass engine represents a great technical achievement, in view of the many aerodynamic and mechanical difficulties to be met in dividing the airflow after the low-pressure compressor. This compressor itself is not an easy design problem on account of the large throughput. It is, therefore, much to Rolls-Royce's credit that they have produced the first successful application of this interesting type of engine. The Conway being the very first example of its type, one must hope that it has not, perforce, arrived on the scene too late for it and its descendants and successors to become historic engines and not merely engines of historical interest. For civil air-line operation there appears to be no very strong incentive at present to go in for the higher speeds which would favour the pure jet.

Plain Words

During the past few weeks of blue skies, baked soil and forest fires, the Institution of Water Engineers has completed its drought recommendations to its members, many of whom may soon be faced with emergencies they have never met before. The problem for the water engineer is a difficult one as its worst consequences can be so very serious. Modern developments in engineering and statistical science have enabled him to estimate the available water supply with an accuracy unknown a quarter of a century ago. He can also forecast with remarkable precision the water demands, the Monday peak and the anticipated all-time monthly high now approaching. He is enabled to forecast the intensity of drought for different probabilities up to once in a thousand years, when extrapolation on his logarithmic scale yields a supply from upland reservoirs just less than 60 per cent. of that probable every year. The difficulties are accentuated considerably by the great increase in industrial demand, coupled with the normal increases in domestic demand. Thus, to-day even a minor drought coupled with excess demand will equate in risk to the major drought of pre-war. A recurrence of the severe droughts of 1788, 1854, 1887 or 1921 inevitably would produce an emergency of no small national significance.

What is so baffling is the nature of to-morrow's weather. Are we to have a really dry summer? Even as we go to press the welcome, gentle rain is dropping, but there is no telling what next week's weather will be. Meteorologists and water engineers have been for ever searching for a rainfall pattern. Three years ago a senior water engineer suggested a simple 33-34 years drought recurrence based on the curious "escarpment" envelope of the Chilgrove (Sussex) records. These records displayed severe droughts in 1854, 1887 and 1921. Although he proffered the modest opinion that the concept might be scientific nonsense, he postulated that 1955 might well fall into this drought pattern. He indicated that the remarkable succession of even rainfalls of the early 1940's should be followed by more oscillatory rainfalls if nature were to retain its normal capricious character. In fact, this is what happened. But the new drought rainfall is still awaited. The year 1955 belatedly tried its best; was it a dress-rehearsal for 1956 just as 1884 was for 1887?

Water supply is not merely concerned with probability, it must always contemplate possibility, and how to bridge the widening gulf between a growing dry summer demand and a falling dry summer yield. But decisions in the realms of probability and possibility are never judged except by the events which follow, and these events seldom if ever coincide with those predicted. Water engineers thus fear that they may cry "Wolf" too often. The nation's fear is that they may not cry "Wolf" at all.

This year, so far, many water suppliers have brought into operation water restrictions, others have reduced compensation water. Yet few have attempted to introduce punitive water charges associated with the price mechanism in order to restrain industrial consumption. Should the drought continue, the water engineer's greatest problem will be to persuade the consumer that blue skies may mean something more than discomfort, they may mean danger: danger to health and danger to employment. Last year in Durham County and Wakefield, despite earnest appeals in all directions, the public did not respond to help themselves by reducing their demands until the stand-pipes were erected. The only satisfactory way to overcome the public apathy towards water waste and the water engineer's dilemma is by a campaign of enlightenment. Something has already been done on television, but something more is needed. Tell the people in unmistakeable terms and they will respond.

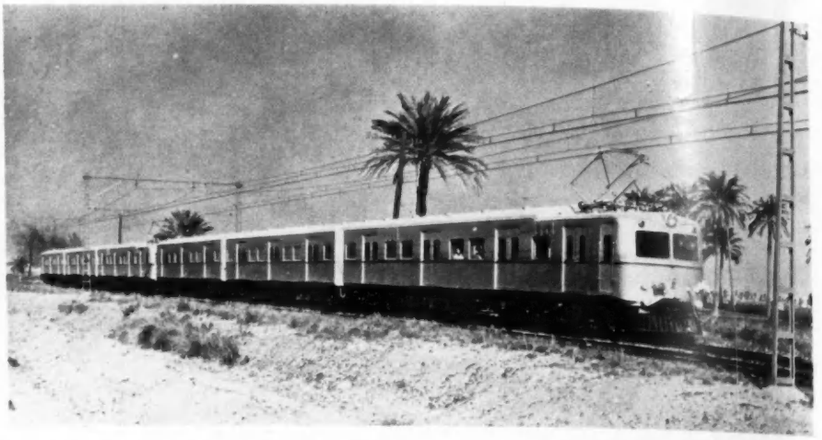


Fig. 1 Experimental operating experience in the Cairo area with electric railway rolling stock has been gained in recent months.

ENGINEERING IN EGYPT

CHANGES AND TRENDS SINCE THE REVOLUTION

It is rarely prudent to accept at their face value the pronouncements of a revolutionary government. In order to justify its existence, such a government is almost bound to discredit its predecessors; it is much more concerned with what former governments failed to do than with what they succeeded in doing. No visitor to Egypt to-day, therefore, should forget this tendency. Only by applying a suitable correction to views emanating from republican sources will it be possible to assess the rate of industrial advance during recent years, and thereby to try to estimate what it is likely to be in future years.

FACTORIES AROUND CAIRO

As a specific example of achievements in the field of public works, one could first choose the new "Corniche" in Cairo, observing that this word has had quite a long journey before it reached the banks of the Nile. Originally applied to the adventurous roads along the cliffs above Monte Carlo, it crossed the Mediterranean and was appropriated for a sea-side promenade or Marine Parade at Alexandria. Now in Cairo the "Corniche" is what would be called elsewhere a riverside drive. The most northerly four-mile section is virtually new; and not only has it been constructed with spectacular speed but, when a bridge spanning the Ismailia Canal has been completed, the road will form a most valuable new traffic link with the Delta. Nearer the heart of Cairo, the improvements are spectacular in the literal sense, fully revealing for the first time how magnificently the city and the river are related. Yet elsewhere in the city and its western suburbs one can see recent and quite important road improvements that were carried out at a more normal pace. This pre-revolution system and the post-revolution development on the east bank are soon to be linked by a new bridge mid-way between the two existing bridges formerly known as the Khedive Ismail bridge and the Abbas bridge. One of the caissons is already in position.

A journey southwards from Cairo offers interesting evidence of rates of industrial progress. On the east bank, the standard-gauge railway to Helwan, a town seventeen miles distant and formerly noted for its sulphur springs, was operated for many years by steam locomotives. Diesel railcars first appeared in 1937; at the present moment all passenger traffic is Diesel operated, but experimental runs of all-electric trains are already taking place. This electrification, on the overhead system, is certainly a triumph for the republican régime, for the project had been discussed—ineffectually—for many years. The present and future density of traffic certainly seems to justify the outlay. Most of the stations on the line have been reconstructed, and more intermediate stations and halts have been opened.

In fact, industrial development in the region began more than twenty years ago, when a cement factory at Tura, ten miles from Cairo, was established under European management. A little further to the south, and dating from about the same period, is a factory for making cement pipes and tiles. Beyond Helwan there is another cement factory, of the pre-war period, which can be regarded as the southern outpost of industrialism here. Yet the railway also gives a view of quite recent projects; at Helwan itself there are new industrial buildings, and on the Nile bank some miles to the north the partly-finished building of the South Cairo power station rises conspicuously. In the future, the centre of gravity of activity will shift further south. According to present plans, the railway will be extended for several miles beyond Helwan to the site of the projected steel factory on the Nile bank and, after crossing the river by a new bridge, it will join the existing main Upper Egypt line on the west bank.

HEAVIER TRANSPORT

Road communications are also to be improved. Here again the need is manifest, for the existing north-south road is seriously over-loaded. If we can believe a report that now lies somewhere between history and legend, this road was itself constructed with remarkable speed in the early years of the century at the command of Lord Kitchener, who was then British Agent in Cairo. Part of the new road on the east bank is visible, and as it is carried on a new alignment over ground which is annually submerged by the Nile flood, its embankment will also serve as a river training wall and is therefore a work of some engineering importance.

During a railway journey northwards from Cairo, the eye-witness method of assessing progress is still serviceable. Main-line trains to Alexandria are hauled by new Pacific-type oil-burning steam locomotives of Continental manufacture that are clearly heavier than any used in pre-revolution days; so it is to be inferred that a long programme of track and bridge improvements must have been carried through to permit these engines to circulate. One of the main items of this programme—the new swing bridge across the Rosetta branch of the Nile at Kafr El Zayat—

was completed by a British firm in 1950. As the train makes its way through the northerly suburbs of Cairo—cautiously because of speed restrictions—there are many signs of activity. Blocks of workers' dwellings are multiplying; there are numerous small factories erected soon after the end of the last war; and the imposing Cairo North electric power station, begun under the former régime, is seen to be in commission. As the railway approaches Alexandria it gives only a long-range view of the outstanding industrial developments in the area, the three establishments at Kafr El Dawar for spinning and weaving, for rayon manufacture and for dyeing, all completed before the revolution and now being extended. The much larger parent establishment for spinning and weaving at Mahalla, in the central Delta, continues in full production.

A traveller who decided to return to Cairo by the desert road would be well rewarded, especially if he remembers earlier days of local motor transport. During the first World War, a track across the sand for Model-T Fords was marked out by beacons. We now see that the tarmac road completed during the winter 1935-36 was quite an effective engineering achievement, for although for much of its length it depended on the mix-in-place process, whereby a mixture of sand and bitumen was laid directly upon the desert surface without any firm foundation, yet the road carried heavy and continuous military traffic to and from the Western Desert battlefields and is still quite serviceable. Post-revolution road improvements are now in progress in the heart of the city, where a broad boulevard will open up the dock area.

Fig. 2 Cotton is a staple industry of Egypt. This weaving factory is at Mahalla.

CANAL IMPROVEMENTS

Sea-going passengers can see what is the most important civil engineering work executed in Egypt since the war. This is the duplication of the Suez Canal for a length of several miles between Ismailia and Kantara. Begun before the revolution and completed after it, this new waterway enables the canal to accommodate the steadily-rising volume of tanker traffic. To the south of Port Tewfik, where the canal debouches into the Gulf of Suez, there is to be seen in the distance an establishment which houses one of the most complex arrays of mechanical equipment in Egypt. It is a synthetic fertiliser plant first put into commission five years ago; designed at that time for making calcium nitrate, it is now being extended so that calcium phosphate can also be produced. Although old and new petroleum refineries are also to be seen here, it is significant that the output of crude oil pumped from Egyptian oilfields is still declining.

To study an achievement that is wholly a conception of the revolutionary era, one must go to the Mudiriet El Tahrir—the "Liberation Province." It lies thirty-odd miles north-west of Cairo, along the desert edge adjoining the cultivated Delta. Here, a score or more square miles of land have already been reclaimed, and in future years the new province is expected to take in several hundred square miles of desert. What is actually to be seen now includes two new villages fully tenanted, other villages under construction, an irrigation network, an extensive range of temporary workshops, the shells of buildings for factories and for permanent workshops, and a 2,000 kW electric power station nearly ready to go into commission. A particular duty undertaken in the temporary workshops is the servicing of the numerous earth-moving and excavating units that are so essential in a land-reclamation scheme. Engineering equipment in the field is naturally devoted chiefly to irrigation. The water is drawn from the existing gravitational canal system of the Delta, but since the reclaimed land lies at a higher level, all the water must be lifted to it—although at the moment the lift is rarely more than a few feet. Vertical propeller pumps geared to oil engines, and horizontal electrically-driven centrifugal pumps—some of them mobile—do the work, while submersible borehole pumps are used to exploit subsoil water.

Communications to the new province are relatively good. The road from Cairo is an extension of a war-time road originally intended to serve a British military camp of which the remains still stand. Water-borne traffic can come along the Behera canal and its branches. An existing standard-gauge railway gives access from the east; yet it is indicative of the trials that may sometimes afflict the new settlers that sand-storms may create sand drifts that temporarily block the line.

THE HIGH DAM

There is a very real—indeed a vital—connection between this reclamation project that has visibly made so promising a beginning, and a far more grandiose project that is still in the design stage. That is the Aswan High Dam. Water impounded by the dam will be needed for the Liberation Province if the cultivated area should expand to its predicted limits; and of course new supplies of irrigation water must also be provided for reclamation schemes elsewhere in Egypt. So the crucial question is: will the High Dam ever be built? The decision to

Fig. 3 Mod[illegible] earth-moving plant has been used extensively to reclaim [illegible] from the desert in the "Liberation Province."

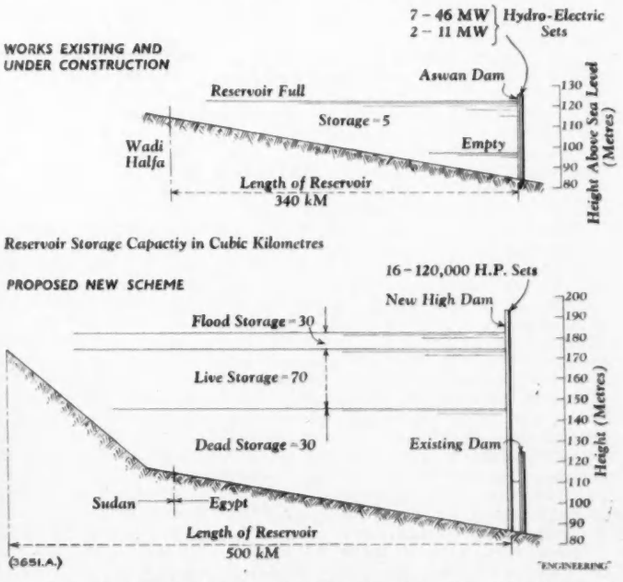


Fig. 4 Control of the Nile is still the heart of Egyptian aspirations. The diagrams illustrate present and future developments at Aswan.

Fig. 5. New architecture in Egypt reflects the influence of Western styles.

build the dam is certainly a post-revolution one, but the original proposal was made public a number of years ago. Its author was Mr. Adrian Daninos. The dam will not be built unless various and daunting problems can be solved, technical, political and financial; yet it is true that signs of activity are visible on the site, such as new access roads.

There is far more activity, however, near the original Aswan Dam, six miles to the north. The hydro-electric scheme planned ten years ago has recently been drastically revised: it now comprises a turbine house upstream of the dam, and four tail-race tunnels carried beneath the existing navigation locks on the west bank and discharging downstream of the western-most sluices of the dam. These tunnels are approaching completion, but although some of the generating plant is ready for delivery at the makers' works in Europe, the date for commissioning the station is given as 1960. As for the projects which may absorb the energy from Aswan—a high-voltage transmission line to the north, an artificial fertiliser plant, or a plant for exploiting the local deposits of iron ore—no constructional work on the ground is yet visible.

In any event it is clear that even if the growth of industrialisation proceeds at the rate recorded before the revolution, the demand for Egyptian technicians and technologists will increase accordingly. This has been recognised. At the University of Alexandria, completely new buildings have been put at the disposal of the Faculty of Engineering, and extensions are already planned. At Assiut, the main centre of Upper Egypt and three hundred miles to the south, a new university is to be inaugurated next September.

OPPORTUNITY FOR BUSINESS

What British industrialists wish to know, naturally, is what their share is likely to be in this expanding engineering activity. At the moment the auguries are not propitious. Because of intensified competition from continental Europe and even from the East, the volume of British trade is proportionately less than it was. There are other difficulties, too. Sometimes specifications are framed so stringently that the risks involved in tendering appear to be excessive. Import restrictions may be too onerous, or it may be hard to obtain visas authorising British representatives to stay in Egypt for a sufficiently long period. Yet the source of frustration does not always lie in Egypt. In spite of quite useful publicity that Egyptian authorities undertake, the conditions there often appear to be imperfectly understood in Great Britain. Admittedly, it would be unreasonable to blame engineers for the ignorance about the Aswan High Dam that is displayed, for instance, in parliamentary debates, but they are responsible for ensuring that material and equipment supplied to Egypt is suitable for that country. Full details, of course, are known to British commercial agents in Egypt, who have to struggle additionally against the ill-feeling aroused among possible Egyptian clients by the system of level tendering that has unhappily spread from England across the Mediterranean.

One asset available to British representatives still exists, although it may be a wasting asset: the use of English as a language. Their work must be carried out more and more by Egyptian engineers with a good knowledge of English. There are many such engineers who have studied under English professors in Egypt and a few who have spent some years in Great Britain doing post-graduate research. The resulting fund of personal good-feeling has by no means been dispersed by recent events; but knowledge of the English language will progressively decline unless present educational trends in republican Egypt are modified.

BIRTHDAY HONOURS

The Birthday Honours List contained the names of many professional engineers, as well as those of scientists and industrialists, who have rendered distinguished service to the engineering and kindred industries, both in Britain and throughout the Commonwealth.

Heading the list is the notice that Lord Cherwell has been created a viscount. He has been professor of experimental philosophy at Oxford since 1919 and was for many years the close scientific adviser of Sir Winston Churchill. Twice he held political office, as Paymaster General, under the former Prime Minister, with responsibility, on the second occasion, for the initiation in this country of the applications of atomic energy. A barony of the United Kingdom has been conferred on Lieutenant-General Sir Ronald M. Weeks, K.C.B., C.B.E., who, in addition to his work as chairman of Vickers Limited, and on the boards of other prominent industrial concerns, has played a noteworthy part in the fields of education and research, including chairmanship of the National Advisory Council for Education in Industry and Commerce, and presidency of the British Scientific Instrument Research Association.

The inclusion of the names of Mr. Allan S. Quartermaine, C.B.E., and Mr. Austin I. Anderson in the list of knights bachelor will give general pleasure to the engineering and shipping industries. Mr. Quartermaine was President of the Institution of Civil Engineers during the 1951-52 session and has recently undertaken the responsible task of expanding the number of professional engineers in the service of the British Transport Commission, while Mr. Anderson, chairman of the Orient Line since 1952, occupies a position of distinction in British shipping and it is in recognition of his services to that industry that his honour has been awarded. Among others upon whom knighthoods have been conferred may be mentioned Mr. Horace W. Clarke, chairman of the Aluminium Industry Council, and Mr. Horace S. Gibson, C.B.E., managing director of the Iraq Petroleum Company, Limited, and associated companies. Mr. George H. Dowty, M.I.Mech.E., chairman of Dowty Equipment Limited, Cheltenham, and a director of their associated companies, is also among the recipients of a knighthood. It is a deserved tribute to his activities in promoting the welfare of the disabled and to his work as chairman of the Cheltenham and North Gloucestershire Disablement Advisory Committee.

Many distinctions have been conferred on engineers and scientists associated with the fighting services. Mr. A. E. H. Masters, C.B.E., M.I.Mech.E., Director to the Fighting Vehicles Research and Development Establishment of the Ministry of Supply, has been made a Companion of the Order of the Bath; Mr. D. H. Black, chief scientific officer to the Ministry of Supply, has been made a Companion of the Order of St. Michael and St. George; Mr. Lewis Boddington, A.F.R.Ae.S., deputy chief scientific officer of the Ministry of Supply, engaged on aircraft research and development, has received a Commandership of the Order of the British Empire; Mr. J. R. V. Dolphin, chief engineer of the Atomic Weapons Research Establishment, United Kingdom Atomic Energy Authority, has also received a C.B.E.; and Mr. L. H. Bedford, O.B.E., chief engineer of the guided weapons division of the English Electric Company, Limited, has been promoted to the same status.

Among others upon whom a C.B.E. has been bestowed are Mr. William B. Atkin, director, general manager and secretary to the Newcastle and Gateshead Water Company; Mr. R. P. Beddow, executive director to the British Electric Traction Company, Limited; Mr. Russell M. Currie, head of the work study department of Imperial Chemical Industries, Limited; Mr. Leslie N. Duguid, deputy chief inspector of factories to the Ministry of Labour and National Service; Mr. Robert Kean, O.B.E., Director of the Federation of Civil Engineering Contractors; Mr. A. B. Mann, O.B.E., M.I.C.E., M.I.Mech.E., chief mechanical and electrical engineer to the Ministry of Works; and Mr. Charles Sykes, managing director of Thomas Firth and John Brown, Limited. The distinction of Officer of the Order of the British Empire has been conferred on Mr. P. Hope E. Bagenal, F.R.I.B.A., for services in the field of acoustics, and on Mr. C. A. Masterman, M.I.Mech.E., M.I.Gas. E., technical director for underground gasification trials to the Ministry of Fuel and Power.

★ ★ ★

Letters to the Editor

PASSENGER MOVEMENT

Conveyor Belt System of 1904

SIR, I was interested to read on page 377 of your issue of May 18 the description of an American project for carrying passengers by belt conveyor, displayed in model form at the recent Mechanical Handling Exhibition at Earl's Court.

From the article it would appear that the "Speedwalk" bears a remarkable resemblance to a contrivance for continuous passenger transportation which this company had on view as long ago as 1904, at an exhibition which, by coincidence, was also held at Earl's Court.

This similarity is evident from a perusal of the two arrangement drawings I am sending you, dated August 1, 1904. Among other things, the two systems are comparable in the varying speeds, actual speed of transportation, acceleration, deceleration, and the spacing of the cars.

I am not aware of any installation having been put into use on a commercial scale at the beginning of the century, but it will be clear that the novelty of the idea which we exhibited anticipated the American project known as the "Speedwalk" by over fifty years.

The foregoing demonstrates that there is still truth in the old adage "there is nothing new under the sun."

Yours faithfully,
for ROBERT DEMPSTER & SONS, LTD.,
B. C. MORTON, M.I.Mech.E.,
M.Inst.Gas E.,
Managing director.

Rose Mount Iron Works,
Elland, Yorkshire.
May 25, 1956.

Editor's Note: The drawings accompanying this letter show the "Rapid Transit Passenger Platform" which consisted of two parallel tunnels each 10 ft. dia. by 650 ft. long, with a loop at each end for passengers to board and alight. A total of 164 "carriages" were capable of moving 7,000 passengers per hour at a maximum speed of 12 m.p.h. At the boarding and alighting points, the speed was only 2 m.p.h., the increase being made possible by a unique system of gears. For those who preferred to walk, a stationary platform ran alongside the carriages, but the time taken on a single journey in walking at 2 m.p.h. was 3 mins. 45 secs. compared with 44 secs. riding.

Weekly Survey

Cover Picture. *About a month ago, on May 11, our cover picture showed the neck of a high-pressure alloy steel air cylinder being forged to shape in a special hydraulic press. This week's picture shows a series of the air cylinders being checked for length after the neck-forging operation.*

* * *

Dual-Fuel Diesel Locomotives

A system has been developed in the United States which, the makers claim, will save American railroads millions of dollars a year. The equipment, which is for installation on standard Diesel locomotives, enables the driver to switch over from a middle distillate oil to a residual oil as soon as the engine is running hot. So far, four railroad companies have begun to experiment with the equipment, which was developed by Nemec Combustion Engineers, Whittier, Cal.

If successful, the Nemec device will have two major effects. First it will help to reduce railway running costs, since the residual oil costs 6 cents a gallon, compared to 9 to 11 cents for Diesel oil. New York Central Railroad expect they could use a dual-fuel system on up to 80 per cent. of their freight service, with an annual saving of 2 million dols. Southern Pacific, who have so far converted 50 of their locomotives, hope for even greater savings. The second effect will be to restore a balance in the consumption of oil refinery products, which is badly lacking at present. The consumption of middle distillates has increased so rapidly, particularly by the railways, that a shortage is developing. The oil companies are therefore keenly interested in these developments, but a good many difficulties have to be overcome before the system becomes established. Residual oil has a high sulphur and vanadium-salt content, both of which are extremely corrosive. It is also liable to deposit impurities very quickly if used at low temperatures, when the locomotive is idling. The locomotive builders are therefore holding themselves aloof, insisting that the tests are strictly the responsibility of the railroads.

In this country, British Railways are well aware of the developments, but have not yet placed the item on their research programme. It is doubtful whether the high traffic density and relatively short hauls would make the utilisation of the system possible in the U.K., but there may be important applications in the Commonwealth. The Nemec duel-fuel system could therefore be of considerable interest to British locomotive builders, though they are hardly likely to be more favourably disposed towards it than G.M.C. and others in the U.S.

* * *

Scotland's Engineering Progress

The volume of industrial output in Scotland increased by 1½ per cent. in 1955 compared with 1954, in marked contrast to the 6 per cent. increase in the previous year. There was a marked slowing down in the rate of expansion in activity in the last quarter of the year, rather more so than in the United Kingdom as a whole. Full figures of Scotland's exports are not available but there is some evidence that those from the engineering industry increased appreciably in 1955. These and a large number of other facts about the economic state of Scotland were recently published in a White Paper under the title *Industry and Employment in Scotland*, 1955.

Although the rate of increase of industrial activity was perhaps somewhat disappointing over the year as a whole, the White Paper showed that progress continues to be made in diversifying Scotland's engineering activities. There was a much greater expansion in electrical than in mechanical engineering. Expansion in exports was particularly noticeable in light engineering. Companies making industrial instruments expanded their output rapidly. In individual cases there were increases of as much as 40 and 50 per cent., and 45 per cent. of the industry's production went abroad. The office machinery industry continued to expand and 33 per cent. of total U.K. production is now concentrated north of the border. The production of clocks and watches increased by 13 per cent. over the year. In a year of outstanding activity for the electrical engineering industry, rotating machinery, transformers, switch and control gear and allied equipment were particularly active. The output of domestic electrical appliances showed little change compared with 1954. The electronics industry, which has been slow to develop in Scotland, is said to be making satisfactory progress under the joint scheme now operated by the Ministry of Supply and the Scottish Council (Development and Industry).

There have been rumours that Mr. Harry Ferguson, if and when he goes into production with his new vehicle, may begin production on Clydeside. Scotland could certainly do with a larger share of the motor vehicle and, for that matter, the aircraft industry. The aircraft industry in Scotland is represented at the moment by Scottish Aviation, Limited, which is producing the Pioneer in quantity, by the Rolls-Royce works producing and repairing turbine engines and by a small share of the aircraft components industry. As for many years, Scotland's main interest in the motor vehicle industry is in commercial vehicles which had a successful year in 1955.

* * *

Fierce When Roused

Most Englishmen seem under the impression that a Scottish Nationalist is an eccentric fellow with a knife between his teeth and a talent for stealing large stones. Such Englishmen have clearly never met a Scottish Nationalist. Probably this misconception explains the failure in England to take seriously a movement which has some appeal even for those Scotsmen who do not actively support it. In fact, any Scotsman with a flair for polemics can present arguments in its favour which an Englishman would find difficult to dispute.

A minor grievance, perhaps, but one which is typical of many, has been brought to our notice by a Glasgow business man, who observes that because the majority of publishers are based in London, Scottish industries, and small firms in particular, tend to be neglected in the technical Press, no matter how interesting their products or novel their production methods. This is not due to indifference or deliberate evasion but to the difficulty of arranging regular Press visits when travelling distances are appreciable.

In an attempt to remedy this omission we have independently paid several extended visits to Scotland with the object of collecting information at random on Scottish industry. We have concentrated mainly—though not exclusively—on smaller firms and, beginning this week, we are publishing the results.

The war-cry of the Clan Robertson is "*Garg'n uair Dhuisgear*" and Scotsmen in general are supposed by Englishmen to be "fierce when roused"; in that case we should be wise not to provoke them. So far, Scotsmen have not been sufficiently roused to sever the mutually beneficial link joining North and South, but the bond can only be maintained if Scotland feels it is getting a fair deal. ENGINEERING's contribution may be a small one, but we hope it may help persuade the Highlander to restore his *sgian dubh* to its sheath.

* * *

Civil Engineers for Africa

All Africa is awakening to the need for more industry and to the greater contribution the Africans can make to world economy, with simultaneous benefit to themselves. In central and eastern Africa great hydro-electric schemes—as at Kariba—are under construction, roads and railway systems are being expanded, and factories built. Developments in Egypt are the subject of an article elsewhere in this issue. In January, at the time of the Queen's visit to Nigeria, we described new works—power stations, roads, harbours—recently completed or under way in Britain's largest colonial territory.

Now the Eastern Regional Government of Nigeria is to begin extensive programmes of road and bridge construction and of urban and rural water supply as well as other development projects in the region. As a preliminary the Government have to recruit many civil engineers to design and supervise the work, and for this purpose two Ministers, the Hon. E. P. Okoya (Transport) and Dr. the Hon. W. N. Onubogu (Development), accompanied by the region's Director of Public Works, Mr. W. D. B. Kingston, M.I.C.E., are to visit the United Kingdom and the Continent this month.

Improved means of communication are the first need. Large sums of money have been earmarked for roads and bridges, for nothing enables native communities to raise their own standard of living more quickly than being able to drive lorries into the established towns, bringing with them the crops that have been cultivated. Road building—and water supplies—are the responsibility of newly-formed county councils and rural district councils which have been created on the pattern of United Kingdom local government. Inland waterways are to be improved, and encouragement is to be given to the erection and maintenance of river jetties, piers and wharves; the boat yard at Opobo is already turning out many modern craft with the object of greatly increasing passenger and launch traffic. The region has three airports, at Enugu, Port Harcourt and Calabar, the last of which is now to be raised to the status of an international airport; improvements are under consideration and the further development of internal air services is proposed, including the construction of new airfields at the largest towns not at present so served. Modern techniques are readily accepted in such areas as Nigeria; there is not the same resistance to new methods as exists in some older and more conservative communities.

* * *

Harwell Thinks First

A research establishment is concerned primarily with the future. The experiments it carries out to-day are the foundations of to-morrow, and on Harwell, perhaps more than any similar institution, our prospects may depend. Questioners at a Press conference held during the recent Open Days expressed anxiety about the comparative rates of progress in this country and in the United States and U.S.S.R., but they needed only to assimilate the information they had gathered during the tour of the establishment to be reassured. Some of the items shown are described in this issue.

Harwell, Sir John Cockcroft has said, is "charged with the task of performing basic research and early development work on all aspects of atomic energy, and particularly to provide new ideas on the generation of power from nuclear sources." This duty has been discharged with great efficiency. Already, as the Deputy Director, Dr. B. F. Schonland, has remarked, preparations are being made for the second stage in the nuclear power programme when plutonium from stage one reactors will be available; this will serve to enrich uranium and provide a satisfactory fuel for the new reactors. Two kinds of reactor are under examination for this stage: the water-cooled reactor and the sodium-cooled graphite-moderated system. Their advantages over gas-cooled reactors—though as yet there are corrosion and other technical problems to be solved—include a lower initial uranium investment and perhaps slightly lower capital costs. A prototype might be built by 1960 and general construction begin later in the same decade.

Work is also being performed on reactors which may reach large-scale application still later—the 1970's. The objective here is to achieve breeding to reduce the amount of

uranium required to obtain a given power output by a hundredfold. The fast reactor is the first of these. The Dounreay reactor has two precursors—ZEPHYR and ZEUS—which have been built at Harwell to study the breeding capabilities and nuclear properties of fast reactors using plutonium and uranium 235 as fuel. Studies are also being made of several other advanced reactor systems. Among these is the aqueous homogeneous reactor, which uses a liquid instead of a solid fuel; the liquid is likely to be a uranium salt dissolved in heavy water with a heavy-water thorium dioxide slurry surrounding the core to produce more uranium 233. Fuel and fission product processing is thus slimplified. Apart from these projected reactor systems, there is evidence that reactors using uranium dissolved in liquid bismuth, and helium-cooled reactors driving gas turbines in closed circuit, are also being developed.

Not only is it necessary to build low-power small-scale models of projected reactor systems (these are somewhat limited in scope) but it is equally important to have materials testing reactors. These provide facilities for investigating many systems or components of systems by means of loops which pass into the reactor core. Examples of these at present under construction are DIDO, PLUTO and LIDO. DIDO (E443), which is shown in an illustration on this page, is designed primarily for materials testing, and is due to become critical in August, while PLUTO (RE775) will be used for the investigation of engineering loops. LIDO (451), a swimming-pool reactor, will provide facilities for shielding studies—an important factor in the development of reactors for ship and aircraft propulsion.

Thus, we have no cause to fear that the Americans, who with their large stocks of uranium 235 can run numerous different prototype systems, will leave us behind. Limitations can sometimes be an advantage and because we must husband our resources we have also to husband our ingenuity. As Dr. J. V. Dunworth, head of the Reactor Division, has observed: "A little thought in advance will save money." Thus by taking thought, by making skilful use of test reactor loops, by performing careful theoretical analyses, by employing analogue computers, we may reach the correct answer more quickly than those who have only to conceive a new reactor system to build a prototype.

★ ★ ★

Exhortation at a Discount

Mr. Macmillan is in danger of forgetting the warning of King Canute. He continues to exhort the rising tide of wage demands with singularly little effect. The very day last week when he issued a solemn warning at the luncheon of the Association of British Chambers of Commerce saying that men's jobs were at risk until the wages-prices spiral stopped, moves were afoot for bigger wage demands. The Associated Society of Locomotive Engineers and Firemen was at that moment putting the finishing touches to a demand for a 15 per cent. increase in wages. On the other side of the table, the Engineering and Allied Employers National Federation issued a statement that it would refuse any further demands for higher wages, knowing full well that such demands are on the way. The National Union of Mineworkers is expected to put forward new demands after its annual conference next month. The Government has already said that the economy of the country cannot stand another round of wage increases, and negotiations are to go on between certain Ministers, employers' organisations and the nationalised industries over the next few weeks on the stabilisation of prices.

It is true that the policy of dis-inflation is beginning to show the first signs of success. The demand for certain types of consumer goods is weakening, but the impact of deflation on capital goods is woefully obscure and could yet be downright harmful if the output of the wrong type of capital goods contracted quickly. The official index of industrial production for April showed that the output for industry as a whole had tapered off notably in consumer goods, but that there was also a fall in building activity. Employers and Government alike may be hoping that the fall in industrial activity will curb the ardour of the trade unions in their demands for higher wages, but the attitude at the moment seems, at best, to be that the unions might take a little less than they had originally wanted but that they will certainly insist on getting something extra. Under such circumstances mere exhortation is not a policy. It is necessary to formulate concrete proposals for the stabilisation of prices and wages, especially to decide when the current twist of the spiral is thought to be coming to an end and a new one beginning.

★ ★ ★

Chemical Engineering Accelerated

The chemical industry is one of the most progressive in the country. Since the turn of the century it has increased enormously—a growth made possible by the advances in knowledge that have stemmed from research. It is clear, however, that the ever increasing rate of expansion calls for yet more and more research and development.

The announcement by the Association of British Chemical Manufacturers that they have set up a committee to be known as the Chemical Engineering Research and Advisory Service Committee marks a significant step forward in the recognition of the importance of the interchange of information both on research and on the application of research results. In the deliberations of the Council of the A.B.C.M. which resulted in the setting-up of the committee, due regard was paid to the report of the D.S.I.R. Committee on Chemical Engineering Research (H.M. Stationery Office, 1951) and to the research facilities available in this country.

To the chair there has been appointed Mr. E. W. Greensmith of Imperial Chemical Industries, Limited; and Dr. E. H. T. Hoblyn and Mr. J. Davidson Pratt, who are respectively the directors of the British Chemical Plant Manufacturers Association and of the Association of British Chemical Manufacturers, will be *ex officio* members. Mr. G. A. Dummett has been appointed liaison member for the former association and Mr. Trefor Davies has been appointed to the staff of A.B.C.M. as technical executive officer to the committee.

It is noteworthy that setting up this A.B.C.M. committee is matched by—and linked with—the establishment of a similar committee by the British Chemical Plant Manufacturers Association, of which committee Mr. Dummett is chairman. These joint actions by the producers of chemical plant and by the users of this plant augur well for the future of the industry as a whole.

It is understood that the committee will first attempt to determine the extent to which chemical engineering research is being done (in so far as this research is not confidential) and, particularly where results are of wide interest, steps will be taken to make them known to the process industries generally. Perhaps of even more immediate importance, the committee will attempt to determine the extent to which information is urgently needed and the nature of such needed information. When the facts have been established it will be possible to encourage a greater measure of willingness to exchange information between firms.

It is too early to forecast the outcome of these efforts, but it is to be hoped that any unnecessary duplication of effort which is revealed will be eliminated, and that still more effective use may be made of existing information and research facilities.

The skilful use of materials testing reactors such as DIDO, which is due to become critical in August, may save the construction of expensive prototype reactors. (See "Harwell Thinks First.")

75 Years of Instrument Making

For many years it has been the practice of the Cambridge Instrument Company, Limited, to invite as many as possible of their representatives from provincial and overseas branches to come to the London offices in order to confer with the directors on matters of mutual interest, business usually concluding with an informal dinner. The 32nd annual conference has just been held and the dinner, which was given on Friday, May 25, at the Rembrandt Hotel, South Kensington, had a wider interest than usual owing to the circumstance that the company is celebrating this year the 75th anniversary of its foundation. In addition to the representatives, some of the senior members of the staffs from the company's three works at Cambridge, Muswell Hill and North Finchley were invited to the dinner, as well as a number of persons not directly connected with the organisation but interested in its products and prospects; about 100 persons were present.

A noteworthy feature of the dinner is that it was presided over, for the first time, by Dr. P. Dunsheath, C.B.E., M.A., M.I.E.E., who became chairman of the company only a few weeks ago, although he has been a member of the Board of Directors since 1950. After the loyal toast had been honoured, the Chairman read messages conveying greetings and good wishes from representatives and friends in many parts of the world. The toast of "The Representatives" was then proposed by Mr. W. H. Apthorpe, M.I.E.E., managing director, and Mr. S. M. Matthews, F.I.C.F., Sheffield district representative, replied. The toast of "The Company" was proposed by Mr. G.

Rayner, M.I.E.E., manager of the Muswell Hill works, and the chairman made the response. In the course of his remarks Dr. Dunsheath referred to the state of industry at the time of the foundation of the company in 1881 and to the influence of the Paris Electrical Exhibition, held that year, on the subsequent developments. To these, he said, the company had made notable contributions. In conclusion, he added, their present policy was threefold, covering care of the staff, care of the shareholders and care for the customers' interests, all of which demanded considerable creative thinking on the part of the management.

★ ★ ★

Rail Electrification Across Frontiers

A major scheme of rail electrification has been agreed by the railways of France, Luxembourg, the Saar, W. Germany and Belgium. The lines to be electrified, which total 116 miles, connect the big German railway marshalling yard at Ehrang, north of Trier in Germany, with the industrial basins of Lorraine and Luxembourg. It is an area of vital importance to the industries of the European Coal and Steel Community, and the scheme is tangible proof that the integrating function of that Community is being fulfilled. The capital cost of the installation is estimated at £4·3 million, of which 31 per cent, will be in Germany, 51 per cent. in Luxembourg, 4 per cent. in the Saar and 14 per cent. in France. Thirty-three electric locomotives, costing a total of £3·6 million will replace the 70 steam locomotives now in service, with an expected saving of 60,000 tons of coal a year. The estimated annual savings in working costs will be about £500,000 which suggests that the scheme is a very sound financial proposition. A considerable increase in the volume of traffic is expected.

The committee who worked out the scheme consisted of the railway managers of the five countries concerned. The way in which the technical and not the political factors determined the main features of the scheme is a most hopeful pointer to the future industrial development of Western Europe. The choice of single-phase alternating current at 25,000 volts and industrial frequency (50 cycles) was determined by the economy and efficiency of this system as proved in north-east France, and also by the fact that the Saar is beginning to electrify its principal lines using the same system. The locomotives will be designed to run over the lines of all the administrations concerned but are expected to be of basic French design (see ENGINEERING, vol. 179, page 658, 1955), and owned by the French and Luxembourg railways. The question of payment for mileage covered in Germany (42 miles of track) and the Saar will be covered by special agreement. Current will be supplied by two sub-stations, one in Luxembourg and the other in France (Thionville). A detailed technical investigation is to be conducted under the guidance of the SNCF to determine whether the installation of a third sub-station at Ehrang in Germany is necessary.

This "international" electrification scheme (described in detail at the project stage in ENGINEERING, February 3, 1956), may well prove to be the forerunner of a standard inter-European electrified railway system. The economies expected, which are high in relation to the capital investment required, will act as a powerful incentive to further co-operation in this field between the nations of Western Europe. It is the logical result of the political and economic steps that have been taken since the war towards the creation of "one market."

★ ★ ★

High Voltage Electric Power Transmission

Since the International Conference on Large Electric Systems (familiarly known as CIGRE) was founded shortly after the 1914–18 war, it has met 16 times, the latest gathering being that which opened in Paris on May 30 and continued until June 6. During that period the term "high tension," as applied to electricity supply, has assumed a different meaning and has acquired added importance. This is shown by the fact that on this occasion some 1,600 members from 45 countries attended and that nearly 120 papers have been presented for discussion. The most interesting of these were the sixteen which were dealt with towards the end of the meeting; they will record the achievements which have taken place in power transmission at voltages exceeding 220 kV and will indicate probable future progress in the same field.

The achievements were well summarised in a report by Mr. P. Sporn, which showed that the present limiting voltage was likely to be in the neighbourhood of 400 kV; and that, as might be expected, development was likely to be greatest where the sources of power were most remote from the centres of consumption. For instance, full details were given of the 400 kV line, which has been designed to transmit 1,150 MW from the Kuibishev hydro-electric plant some 500 miles to Moscow; of a 380 kV system in Finland also based on water power and of similar developments both in Australia and Germany. As pioneers in this field what Messrs. Jancke and Lalander had to say about the position in Sweden attracted much attention—particularly the remark that 650 kV may be regarded as the highest conceivable operating voltage.

While this group of papers will be of the most general interest, the proceedings will also have their attractions for the specialist. The transmission of electric power under modern high-voltage conditions necessitates close attention being given to the design and operation and plant of all kinds (particularly transformers, circuit-breakers and protective gear); and the Conference, as is usual, provided an excellent opportunity for the interchange of information about these subjects on an international basis. This is, of course, its particular value. It is, moreover, a form of collaboration which can be conducted free from political considerations and, at the level that is attained in Paris, almost without what Carlyle called the "cash nexus." This interchange is much facilitated by the excellent organisation of the Conference, the machinery of which seemed this year to be working more smoothly than ever.

★ ★ ★

Standards and Growth

A distressingly high proportion of British engineering concerns find the way to high production efficiency barred by an astonishing variety of designs, accumulated over years, sometimes over more than half a century. They embody the ideas of designers who have improved on this, or added that, or created something new. They embody the wishes of customers from all types of industries in countless markets. It is notoriously easier to sell what the customer wants than what the company makes. Investigation often reveals that thousands of part numbers are used where hundreds would suffice to give the company an effective commercial range. Each part number has a drawing, which has to be filed, and a bin in the stores, and tools in the tool store and endless supporting pieces of paper. Catalogues are crowded and generally so difficult to read that buyers find it quicker to specify what they want and more part numbers are added. Nothing is ever scrapped. When "old Bill" the storekeeper or "old Joe" the chief draughtsman retires no amount of records can give the answers their memories provided. Chaos deepens, new machines fail to yield the expected advantages, incentive schemes do not bring about the increases in productivity hoped for, and so on. The indigestion is so chronic that modern patent industrial medicines cannot cure it.

This may be a caricature, but not without a ring of truth which most managing directors will recognise. The tendency in British engineering in recent years has been to adopt measures to improve production—by method study, time study, personnel managers, incentive schemes, welfare and the like. The sudden emphasis on automatic controls, which have their place in more factories than is generally considered, makes essential a simplification of a company's range of products and the introduction of standards. It is here that the main scope for improvement exists. And when each part is considered, examined for movement and tested for commercial suitability and potential there is a golden opportunity to question the materials of construction. Startling savings have been made by substitution of new for old, which is hardly surprising since the majority of specifications were adopted 15 or more years ago.

There are signs that the main advance in productivity, and the main reductions in costs of materials, in the next decade will be achieved in the promotion of standards and the simplification of products. The standards engineer will come into his own, just as the work study engineer has done in the past decade. A meeting of 120 such executives was held recently in London under the joint sponsorship of the British Standards Institution and the Institution of Production Engineers. It was addressed by Professor H. W. Martin of the Rensselaer Polytechnic Institute, New York, and standardisation consultant to the European Productivity Agency. Professor Martin dealt with standards engineering in its widest economic implications and illustrated how simplification and standardisation had helped American companies to increase productivity. Provided the problem is tackled with commercial as well as technical intelligence, immense gains can be made in this country. The realisation of this is a factor quite vital to the continued expansion of British engineering.

★ ★ ★

Further Expansion at Corby

Stewarts and Lloyds Limited have announced that they intend to spend about £6¼ million on developing their works at Corby. The entire project will take nearly 10 years to complete and the first stage, which is expected to take four years, will be to construct 50 new coke ovens with coal preparation plant and by-products plant. When this part of the programme is completed, work will begin on reconstructing about two-thirds of the existing 143 coke ovens.

The programme is thus partly an expansion of coking capacity and partly a modernisation operation. It is known that Stewarts and Lloyds have for some time considered putting down another large steel works at Corby which will make finished steel products other than tubes, but there is no mention in the announcement of any further progress with that plan. Since, however, new steel-making capacity would require increased supplies of pig iron, any expansion in the output of coke and by-products in the next few years could be made to fit into a more ambitious plant in due course. To that extent, the announcement last week tells everything and nothing.

Corby is rightly associated in most peoples minds as being mainly given over to the production of welded tubes. Until comparatively recently, it was possible to think of Stewarts and Lloyds interests in welded and seamless tubes as being neatly divided: welded tubes in England and seamless tubes in Scotland. Fairly recently, however, the company has installed a small seamless tube mill at Corby so that in a very modest way, the huge works on the Northamtonshire iron ore deposits has already embarked on a career of diversification of finished output.

★ ★ ★

New Gas Pipe-Line Order

Trans-Canada Pipeline Company has given an order worth 32 million dols. for steel piping to the South Durham Steel and Iron Company, Limited. There has been a good deal of difficulty in Canada arranging the finance for the pipe-line, which is expected to carry natural gas for a distance of 2,200 miles across Western Canada, but it has been reported that 90 per cent. of the costs of the pipe-line from Alberta to

Winnipeg in Manitoba, to be built this summer, will be advanced by the Canadian Government early this month.

The contract is for 636 miles of 30 in. steel pipe for the centre section of the project, which runs from Winnipeg to Eastern Ontario and deliveries are due to begin in April, 1957. The section of the line which the South Durham Company is interested will therefore not come out of the expected guarantee.

The contract was obtained against keen United States competition in quality, price and delivery. An interesting aspect of this second contract for gas pipe-line (the company secured the contract for the construction of the Westcoast Transmission Pipeline last October) is the promise it gives of a valuable outlet for steel plate in export markets. Steel plate has been scarce in this country for a long time, and shipbuilders and locomotive builders have good reason to remember the difficulty they have had since the war in getting adequate supplies. It is, however, sound long term strategy for the heavy steel-plate section of the industry to develop a large export market which is not related to shipbuilding, as the new South Durham plant at West Hartlepool is making possible.

★ ★ ★

Higher Lorry Speed Limit in 1957

It is fitting to give a parting salutation to the much welcomed end of the 20 m.p.h. speed limit for heavy goods vehicles which is due next year. The question of ending this notorious anachronism was brought up again last week at the committee stage of the Road Traffic Bill. Like Charles II, the 20 m.p.h. limit is an unconscionable time dying, for the Minister will not make the change immediately the new bill becomes law. Mr. Wilkinson made much of the need to get the co-operation of the various trade and labour organisations affected and it is clear that he is particularly wary about rushing the unions who have for long had a vested interest in the 20 m.p.h. limit.

It has been estimated that about 110,000 vehicles are tied to the limit, about 64,000 being "C" licences owned by private firms. Nearly all drivers break the law by taking advantage of the speed limit in their overall schedules; they enjoy longer stops at transport cafés and then make quicker dashes over parts of the route. This is probably a unique case where "go slow" has had an identical literal and metaphorical meaning. Raising the limit to 30 m.p.h. by ministerial order next spring will sweep away a bad regulation—one that has helped to reduce the efficiency of road transport and has been a hindrance to the development of commercial vehicle design.

★ ★ ★

Disc Brakes to be Standard

Failure of experimental disc brakes in some recent motor races has caused speculation about their future, but at Cwmbran in South Wales, where Girling Limited are spending £2 million reorganising and extending Europe's biggest brake factory, there are no doubts, and a new section is being prepared for production of this type of brake.

A vast amount of test experience has been accumulated both on private cars and commercial vehicles. Cars which normally have a brake lining life of 15,000 to 30,000 miles are running 35,000 to 60,000 miles before overhaul of the disc brakes is required. Extensive testing on public service vehicles has been possible through the co-operation of the enterprising Midland Red company, and it has been found that on extremely hilly routes vehicles which formerly had a brake lining life of 7,000 miles do 25,000 on discs, while buses on easier routes do up to 80,000 miles. Moreover, time taken in re-lining is greatly reduced.

Commercial vehicle manufacturers seem likely to be the first to make extensive use of disc brakes, and several examples should be seen later this year. In the car field, the Austin-Healey 100S, the Aston Martin DB3S and the Jaguar D-type are already available with disc brakes; other sports models will follow, and then the high performance saloons. Discs will most likely be used at the front only, as on the DS19 Citroen in France. Drum brakes are still adequate for the duty at the rear, and make it easier to fit the handbrake. On large cars, discs may save up to 45 lb. of unsprung weight, but there will not be much weight saving on small cars.

The Girling brakes use segmental linings bonded to steel plates with inside calipers which are cut away to allow instant inspection of the friction material. Linings can be renewed without removing the caliper or disturbing the hydraulic connections. With the segment, lining area is proportional to disc area across the face, whereas with circular friction pads, concave wear can occur at the part of the disc covered by the centres of the friction spots. Another trouble which has been experienced with experimental brakes using circular spots has been bonding of the lining to the disc. This can happen in an instant if the wheel locks momentarily while the brake is very hot, and the car then becomes immovable. It happened to a Jaguar during the Sebring race in America, and it happened again during recent tests at Reims in preparation for the Le Mans race. New lining materials have had to be developed to solve the problem.

★ ★ ★

Prospective Loss for B.O.A.C.

The reasons for a prospective loss of £1·5 million in the current financial year, announced last week by the British Overseas Airways Corporation, may well be due to a "technical hitch"—as another public corporation says on some occasions. The news is disturbing for all that. It is known that the Corporation is going to introduce the Britannia and the Douglas DC-7C in the autumn. In consequence, although some of the initial training and trial flight expenses may be spread over a number of years, a fairly heavy burden must be assumed for these in the year ending March, 1957, while these aircraft will have been earning revenue for only about six months. In addition, a pay increase of the order of £750,000 for flying staff has to be absorbed and there have been increases in the price of raw materials.

It is not known what forecast of revenue the Corporation has made in arriving at its estimated loss, but there is no doubt that a period of intensified foreign competition lies ahead. The International Air Transport Association Conference at Cannes which opened last week foreshadowed battle round the conference table, led by the U.S. Government, to reduce fares; may it be that in consequence the Corporation has decided to err on the conservative side in estimating revenue in the current year. There is no doubt that the swing of trading experience from a profit of £1·75 million in the year ended March, 1956, to a loss of £1·5 million for the current year, making change of £3·25 million is too severe for it to be said that B.O.A.C. has as yet achieved satisfactory viability.

The fact that the big battalions are not immune from serious fluctuations of fortune should be borne in mind by the independent air companies who have been recently discussing the possibility of pooling their resources. It is known that these companies feel themselves at a disadvantage in dealing with the Government, whose prime interest is obviously to maintain as far as possible the earning power of B.O.A.C. and B.E.A. If the small independents could strengthen their bargaining position all round by a loose pooling arrangement or even a closer integration into a large independent corporation, they might gradually have some beneficial effect on nationalised corporations—as I.T.A. is beginning to have on the B.B.C. There is one vital difference, however. In the aircraft industry international competition is the vital consideration, and the recent fluctuating fortunes of B.O.A.C. should be a warning to the independents to hurry slowly.

The New Vickers

In his parting address to shareholders the retiring chairman of Vickers Limited, has given some interesting figures of the company's turnover. Sir Ronald Weeks—Lord Weeks in the latest Birthday Honours List—has taken the occasion to divulge both the turnover achieved in 1955 and the split-up by main divisions of activity. Last year, Vickers' total turnover reached £131 million. Of this, aircraft accounted for 31½ per cent. compared with 20 per cent. in 1954. As a result of this percentage increase, the company's general engineering activities declined from 36 to 32½ per cent. between 1954 and 1955. In a similar way, steel was reduced from 25 to 22 per cent. and shipbuilding from 19 to 14 per cent. These changes occurred in spite of the fact that steel is said to have contributed to the results "in a spectacular manner" and although orders for ships reached a new record and the output of general engineering products continued to expand.

Vickers is thus heavily and increasingly dependant for the time being on the aircraft industry, even on the level of military orders for aircraft despite the obvious and continuing success of the Viscount. It would appear that rather more than £40 million a year is sold by Vickers' aircraft division. Companies in the aircraft industry do not publish the size of their turnover or their gross profit percentages, but if the gross profit earned by such companies as the Bristol Aeroplane Company Limited, and de Havilland Holdings, Limited, are at all similar to those earned in other sections of the engineering industry their turnover, too, must be in the region of £40 million a year. Thus Vickers are one of the largest makers of aircraft and aircraft components in the industry.

The company is well diversified in several branches of engineering and metal manufacture but there is no doubt that the growth of the aircraft side must bring with it new problems. The enormous success of the Viscount is clearly of great importance to Vickers both from the point of view of prestige and turnover. The other side of the coin is the increased element of volatility which the increasing stake in aircraft brings with it.

★ ★ ★

The Brush Group, Limited, seem to have considerable affinities with the railways, because both their retiring chairman, Sir Ronald W. Matthews, and their new deputy chairman and joint managing director, Mr. Miles Beevor, have had considerable experience with the London and North Eastern Railway. Indeed, Sir Ronald was chairman of that company for ten years and Mr. Beevor has had the honour of having a locomotive named after him.

It is perhaps essential when companies are grouped together that some of those at the top should have legal and financial training and this in spite of the authority who said that "the efficiency of a company depended directly on the number of engineers on its board of directors." In the Brush Group Mr. Beevor represents the legal aspect, since he was for a time a solicitor in practice in London and later legal adviser to the British Transport Commission. The financial aspect is represented by Mr. Ian T. Morrow, who will be joint managing director with Mr. Beevor and who has specialised in budgetary control and standard costs.

The new chairman of the company, Mr. G. C. R. Eley, has an international background, as he was educated at Trinity College, Cambridge, and Harvard University, Mass.; his interests cover a wide field for he is chairman of British Drug Houses, Limited, a director of the Equity and Law Life Assurance Society and a member of the London Electricity Board. Other directorships that he holds include those of Thomas Tilling, Limited, Richard Crittall and Company, Limited, the British Bank of Iran and the Middle East and the Bank of England.

All three men have served with the Brush Group since its formation and were formerly with the Brush Electrical Engineering Co., Ltd.

THE PROBLEM OF SWAY IN MOMENT DISTRIBUTION

GENERAL TREATMENT USING CONCEPT OF VIRTUAL WORK

By D. H. Clyde, B.SC.(ENG.) (RAND)*

It is proposed to show that the so-called sway corrections in a moment-distribution analysis may be formally treated in a similar manner to the basic joint-balancing procedure. This leads to a simplification of the preliminary work in an actual analysis and a better understanding of the significance of such operations. The treatment assumes a knowledge of the method of moment distribution and consequently does not discuss the underlying assumptions or the type of problem for which the method is suitable.

A moment distribution is started by considering a frame as a set of fixed-ended beams for which end moments are calculated. The process of distributing moments corresponds to releasing and reclamping one at a time such constraints as are necessary to produce this fixed-ended state. The technique was originally devised for, and is best suited to, cases in which the only constraints necessary are those against rotation of the joints.[1] It has been extended for use in general cases by various devices, one of which is the introduction of sway corrections into the main calculation.[2] The necessity for such sway corrections arises when the number of independent equations of statics relating the end moments of the members exceeds the number of joints at which moments are distributed.

* Research Student, Engineering Laboratory, Cambridge University.

The procedure of balancing moments at a joint involves the following steps, most of which are usually implicit. When a certain stage is reached in the calculation the members meeting at joint A will not necessarily satisfy the equation of statics

$$\Sigma M_A = 0.$$

The usual sign convention adopted for this summation is that clockwise moments exerted on the ends of a member are positive.

Suppose $\Sigma M_A = M_R$.

The balancing of the joint involves the imposition of moments M_A' such that

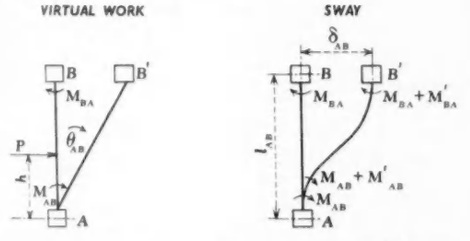
$$\Sigma M'_A = - M_R.$$

As the end rotations were compatible before balancing, the rotation θ_A of all members during balancing must be the same for the process to maintain compatibility. For a prismatic member fixed against rotation at the far end, a rotation of θ_A at A produces a moment at A of

$$M'_A = \left(\frac{4EI}{l}\right)\theta_A.$$

Summing M'_A

$$\Sigma M'_A = \theta_A \Sigma \left(\frac{4EI}{l}\right).$$



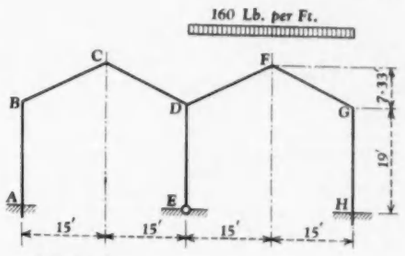
(3447.A.) "ENGINEERING"

Fig. 1 The geometry of a sway may be used to derive an equilibrium equation through virtual work as well as to define a set of compatible end moments.

TABLE I

		Collection factor	Stiffness	Collection factor × stiffness	(Collection factor)² × stiffness	Distribution factor	(Distribution factor) × (collection factor)	Carry over
Joint B	M_{BA}	1·000	4EI(0·0526)			0·468		0·5
	M_{BC}	1·000	4EI(0·0599)			0·532		0·5
			4EI(0·01125)			1·000		
Joint C	M_{CB}	1·000	4EI(0·0599)			0·5		0·5
	M_{CD}	1·000	4EI(0·0599)			0·5		0·5
Joint D	M_{DC}	1·000	EI(0·2396)			0·376		0·5
	M_{DE}	1·000	EI(0·1578)			0·248		0·5
	M_{DF}	1·000	EI(0·2396)			0·376		0·5
			EI(0·6370)			1·000		
Sway (1)	M_{BA}	+1·000	6EI(0·0526)	+0·0526	+0·0526	+0·104	+0·104	
	M_{CB}	−1·293	6EI(0·0598)	−0·0774	+0·1002	−0·153	+0·198	
	M_{DC}	+1·293	6EI(0·0598)	+0·0774	+0·1002	+0·153	+0·198	
					+0·5060		1·000	
Sway (2)	M_{BA}	1·000	6EI(0·0526)			+0·222		
	M_{CB}	1·000	6EI(0·0263)			+0·111		
	M_{HG}	1·000	6EI(0·0526)			+0·222		
			6EI(0·2367)			+0·939		

Joint F and Sway (3) involve the same arithmetic as Joints C and B respectively.
Joint G involves the same arithmetic as Sway (1).



(3447.B.) "ENGINEERING"

Fig. 2 Sway corrections are required for frames, such as the one shown, where there are more independent equations of statics than joints at which moments are distributed. The method developed in the article is used to solve the frame under the loading given.

Hence $$M'_A = - M_R \frac{\left(\frac{4EI}{l}\right)}{\Sigma\left(\frac{4EI}{l}\right)}.$$

Each term $\left(\frac{4EI}{l}\right)$ is usually replaced by a generalised stiffness defined as the moment produced at end A by a unit rotation of joint A when the joint at the far end is held against rotation. The rotation θ_A of joint A also produces a moment $\left(\frac{2EI}{l}\right)\theta_A$ at the far end for the prismatic member considered. The ratio $\left(\frac{2EI}{l}\right):\left(\frac{4EI}{l}\right) = \frac{1}{2}$ is replaced by a similar generalised carry-over factor defined as the ratio of

$$\frac{\text{the moment at the far end}}{\text{the moment produced at A}}$$

when joint A is given an arbitrary rotation and the joint at the far end is held against rotation. The calculation of stiffness, carry-over factors and the terms $\frac{\text{stiffness}}{\Sigma\ \text{stiffness}}$ (which are known as distribution factors) is done in advance of the main calculation. Some writers also point out that the condition

$$\Sigma \text{ distribution factor} = 1$$

may be used to check the calculation of these factors.

The identification of the remaining equations of statics and the correlation of these equations with a mode of deformation is assisted by making use of the principle of virtual work. In order to set up an equation, a suitable mechanism defined by rigid-body rotations is chosen.[3] In general, if AB rotates θ_{AB} clockwise then any other member will rotate $n\,\theta_{AB}$ where n may be positive or negative and need not be an integer but depends entirely on the mode of deformation chosen. The virtual work equation will take the form

$$(M_{AB} + M_{BA})\,\theta_{AB} + (M_{BC} + M_{CB})\,n_1\,\theta_{AB} + \ldots\ldots + M_0\,\theta_{AB} = 0$$

where $M_0\,\theta_{AB}$ is a term arising from the external loads (Fig. 1*a*). θ_{AB} may be eliminated and the equation has the general form

$$\Sigma n M + M_0 = 0.$$

At a certain stage in the calculation this will not necessarily be satisfied.

Suppose $\Sigma n M + M_0 = M_R$.

Additional moments M' must be imposed so that

$$\Sigma n M' = - M_R.$$

This is achieved by using a mode of deformation similar to that used for writing the equation of statics, but continuity is retained while rotation of the joints is prevented. As the geometry will be the same as before, if AB rotates $\left(\frac{\delta}{l}\right)_{AB}$ other members will rotate $n\left(\frac{\delta}{l}\right)_{AB}$

TABLE II

		0·468	0·532		0·5	0·5		0·376	0·248	0·376		0·5	0·5		0·532	0·468	
	M_{AB}	M_{BA}	M_{BC}		M_{CB}	M_{CD}		M_{DC}	M_{DE}	M_{DF}		M_{FD}	M_{FG}		M_{GF}	M_{GH}	M_{HG}
1										−3,000		+3,000	−3,000		+3,000		
2										−7,130		−7,130	+7,130		+7,130		
3	+2,160	+2,160							+1,080							−4,850	−4,850
4	− 450	− 450	+ 663		+ 660	− 660		− 660								+2,160	+2,160
5		−1,110	−1,260					+3,650	+2,410	+3,650					−3,960	−3,480	
6	− 560				− 630	+1,820											
7										−2,120							−1,740
8	+1,840	+1,840							+ 920						+2,120	−1,440	−1,440
9	−1,200	−1,200	+1,760		+1,760	−1,760		−1,760								+1,840	+1,840
10		−1,120	−1,280		− 600	− 590		+1,110	+ 740	+1,110		+ 80	+ 80		−1,340	−1,180	
11	− 560		− 300		− 640	+ 560		− 300		+ 40		+ 560	− 670		+ 40		− 590
12										−1,040		−1,040	+1,040		+1,040	− 710	− 710
13	+1,450	+1,450							+ 730							+1,450	+1,450
14	− 610	− 610	+ 900		+ 900	− 900		− 900									
15		− 670	− 770		+ 40	+ 40		+ 550	+ 370	+ 550		+ 60	+ 50		− 970	− 850	
16	− 330		+ 20		− 380	+ 280		+ 20		+ 30		+ 280	− 480		+ 30		− 420
17										− 700		− 700	+ 700		+ 700	− 480	− 480
18	+ 900	+ 900							+ 450							+ 900	+ 900
19	− 350	− 350	+ 520		+ 520	− 520		− 520									
20		− 500	− 590		+ 50	+ 50		+ 270	+ 180	+ 270		+ 100	+ 100		− 610	− 540	
21	− 250		+ 20		− 300	+ 140		+ 20		+ 50		+ 140	− 300		+ 50		− 270
22										− 430		− 430	+ 430		+ 430	− 290	− 290
23	+ 590	+ 590							+ 290							+ 590	+ 590
24	− 220	− 220	+ 320		+ 320	− 320		− 320									
25		− 340	− 370		+ 80	+ 80		+ 150	+ 90	+ 150		+ 80	+ 80		− 420	− 360	
26	− 170		+ 40		− 190	+ 70		+ 40		+ 40		+ 70	− 210		+ 40		− 180
27										− 270		− 270	+ 270		+ 270	− 180	− 180
28	+ 390	+ 390							+ 200							+ 390	+ 390
29	− 130	− 130	+ 200		+ 200	− 200		− 200									
30		− 230	− 270		+ 60	+ 60		+ 70	+ 50	+ 70		+ 70	+ 70		− 280	− 240	
31	+2,500	+ 400	− 400		+1,850	−1,850		+1,220	+7,510	−8,730		−5,430	+5,430		+7,270	−7,270	−3,820

where the n's have the same value as in the equation of statics. A body rotation $n\left(\frac{\delta}{l}\right)_{AB}$ of a prismatic member produces moments at the ends of the member of magnitude

$$M' = -\left(\frac{6EI}{l}\right) n\left(\frac{\delta}{l}\right)_{AB}. \quad \text{(Fig. 1}b\text{)}$$

Summing $n\,M'$

$$\Sigma n\,M' = \Sigma n \times -\left(\frac{6EI}{l}\right) n\left(\frac{\delta}{l}\right)_{AB}$$

$$= -\left(\frac{\delta}{l}\right)_{AB} \Sigma n^2\left(\frac{6EI}{l}\right)$$

$$= -M_R.$$

Hence $$M' = -M_R \frac{n\left(\frac{6EI}{l}\right)}{\Sigma n^2\left(\frac{6EI}{l}\right)}.$$

All moments defined by this distortion are included in the equation of statics so there are no carry-over factors. Each term $\left(\frac{6EI}{l}\right)$ may be replaced by a generalised shear stiffness which is defined as the moment produced by a body rotation of one radian when the joints at both ends do not rotate. The terms n depend upon the geometry of the structure. Note that all terms in the summation $\Sigma n^2\left(\frac{6EI}{l}\right)$ are positive, but terms $n\left(\frac{6EI}{l}\right)$ take their sign from n. The terms

$$\frac{n\left(\frac{6EI}{l}\right)}{\Sigma n^2\left(\frac{6EI}{l}\right)}$$

may be referred to as sway distribution factors. It has been suggested that the terms n be referred to as collection factors. By implication all collection factors for a simple joint distribution are + 1 since all coefficients in the equations of statics are + 1. This enables a new condition on all distributions to be set up, namely

Σ collection factor × distribution factor = + 1.

The steps of a sway correction have been handled symbolically by recognising the relationship between the co-efficients of the equation of statics and the geometry of the standard types of deformation usually chosen for such a correction. This symbolic treatment enables the preliminary calculation of factors to be done by direct tabulation, and this method is considerably shorter than the calculation of such factors from first principles, as has hitherto been necessary. A method of determining the number of independent sway corrections to be sought is given in an appendix.

EXAMPLE

It is required to find the bending moments in the frame of Fig. 2 under the loading shown. Before it is possible to make a moment distribution analysis it is necessary to calculate the fixed-end moments, the equilbrium equations and the distribution factors.

(1) *Fixed-end Moments*

$$M_{DF} = M_{FG} = -\frac{160 \times 15^2}{12} = -3{,}000 \text{ lb.-ft.}$$

$$M_{FD} = M_{GF} = +\frac{160 \times 15^2}{12} = +3{,}000 \text{ lb.-ft.}$$

(2) *Equilibrium Equations*

The geometry of the displacements is shown in Fig. 3. The equations, therefore, are

(1) $(M_{AB} + M_{BA})\,\theta_{AB} + (M_{BC} + M_{CB})\,(-1{\cdot}293\,\theta_{AB}) + (M_{CD} + M_{DC})\,(1{\cdot}293\,\theta_{AB}) = 0$

i.e. $M_{AB} + M_{BA} + 1{\cdot}293\,(-M_{BC} - M_{CB} + M_{CD} + M_{DC}) = 0.$

TABLE III

M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{CD}	M_{DC}	M_{DE}	M_{DF}	M_{FD}	M_{FG}	M_{GF}	M_{GH}	M_{HG}	M_0	M_R		
+1·000	+1·000	−1·293	−1·293	+1·293	+1·293								0		Collection	Sway (1)
+0·104	+0·104	−0·153	−0·153	+0·153	+0·153										Distribution	
+1·000	+1·000					+1·000					+1·000	+1·000	0		Collection	Sway (2)
+0·222	+0·222					+0·111					+0·222	+0·222			Distribution	
							+1·293	+1·293	−1·293	−1·293	+1·000	+1·000	+46,600		Collection	Sway (3)
							+0·153	+0·153	−0·153	−0·153	+0·104	+0·104			Distribution	
0	0					0	−3,880	+3,880	+3,880	−3,880	0	0	+46,600	+46,600	Sway (3)	Line 2
+2,160	+2,160	0	0	0	0						−4,850	−4,850		− 9,700	Sway (2)	Line 3
														+ 4,320	Sway (1)	Line 4
−1,010	−1,560													+13,870		Line 7
+1,280	+ 730	+1,630	+ 810	+2,360	+4,720	+2,410	+4,730	+2,360	+2,560	+5,120	−1,320	+ 420		− 8,260		Line 8
											−4,920	−3,180		+11,530		Line 9
−1,760	−2,320										+ 760	+1,250		+ 6,780		Line 12
+ 890	+ 330	+1,660	+ 830	+ 720	+1,440	+ 740	+1,440	+ 720	+ 870	+1,740	−1,890	−1,300		− 6,530		Line 13
														+ 5,870		Line 14
− 940	−1,280										+ 600	+1,030		+ 4,570		Line 17
+ 570	+ 230	+1,000	+ 500	+ 360	+ 710	+ 370	+ 710	+ 360	+ 620	+1,250	−1,330	− 900		− 4,080		Line 18
														+ 3,370		Line 19
− 600	− 850										+ 460	+ 630		+ 2,800		Line 22
+ 340	+ 90	+ 760	+ 380	+ 350	+ 180	+ 180	+ 350	+ 180	+ 390	+ 790	− 830	− 560		− 2,650		Line 23
														+ 2,100		Line 24
− 390	− 560										+ 230	+ 410		+ 1,740		Line 27
+ 220	+ 50	+ 480	+ 240	+ 100	+ 190	+ 90	+ 190	+ 100	+ 270	+ 540	− 540	− 360		− 1,760		Line 28
														+ 1,280		Line 29

Checking Moments after six complete cycles.

1. 2,500 + 400 + 520 − 2,390 − 2,390 + 1,580 = +220
2. 2,500 + 400 + 7,510 − 7,270 − 3,820 = −680
3. −7,270 − 3,820 − 9,420 − 7,020 − 7,020 − 11,290 + 46,600 = +760

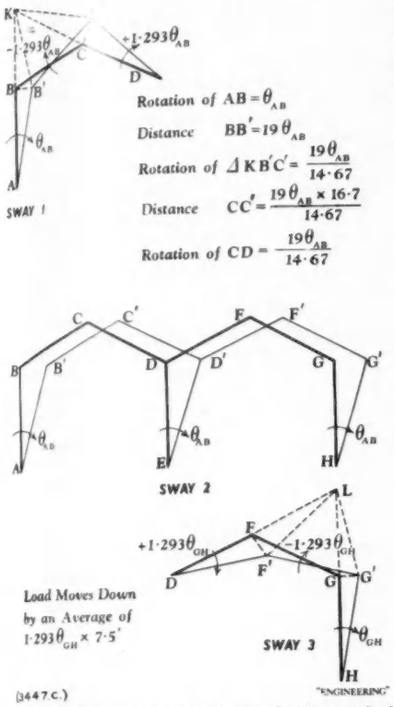

Rotation of AB = θ_{AB}
Distance BB' = 19 θ_{AB}
Rotation of Δ KB'C' = $\frac{19\theta_{AB}}{14\cdot67}$
Distance CC' = $\frac{19\theta_{AB} \times 16\cdot7}{14\cdot67}$
Rotation of CD = $\frac{19\theta_{AB}}{14\cdot67}$
SWAY 1
SWAY 2
SWAY 3
Load Moves Down by an Average of $1\cdot293\theta_{GH} \times 7\cdot5'$
(3447.C.)
"ENGINEERING"

Fig. 3 The sway corrections of the worked example are derived from the geometry of the displacements shown. Sway corrections are a moment distribution process similar to that used for satisfying joint equilibrium.

(2) $(M_{AB} + M_{BA})\,\theta_{AB} + M_{DE}\,\theta_{AB} + (M_{GH} + M_{HG})\,\theta_{AB} = 0$

i.e. $M_{AB} + M_{BA} + M_{DE} + M_{GH} + M_{HG} = 0.$

(3) $(M_{GH} + M_{HG})\,\theta_{GH} + (M_{DF} + M_{FD})(1\cdot293\,\theta_{GH}) + (M_{FG} + M_{GF})(-1\cdot293\,\theta_{GH}) + 160 \times 30\,(1\cdot293\,\theta_{GH})\,7\tfrac{1}{2} = 0$

i.e. $M_{GH} + M_{HG} + 1\cdot293\,(M_{DF} + M_{FD} - M_{FG} - M_{GF}) + 46{,}600 = 0.$

The five joint-equilibrium equations are simple enough not to need writing out.

(3) *Distribution Factors*

The calculation of all types of distribuition factor is handled in Table I. The columns are arranged to lead to the final summation of (collection factor)^2 × stiffness, and of distribution factor × collection factor. Where collection factors of + 1 would mean repeating the same column of figures, this summation is carried out on the first occasion the figures appear, that is, in the stiffness and distribution factor columns respectively.

(4) *Moment Distribution*

The basic tabulation is grouped to suit the pattern of joint distribution (Table II). Joint distribution factors are abstracted from Table I above the relevant moment columns. A full line across the table means that above this line all joints are balanced (lines 5, 10, 15, 20, 25 and 30). It is followed immediately by the carry-overs resulting from the balance (lines 6, 11, 16, 21 and 26). Any one balance only concerns changes in moment since the previous balance.

Except for lines 1 and 31 the remaining lines of Table II are sway corrections. The arithmetic of these corrections is handled in Table III. It was to assist the tabulation of this arithmetic that the use of the term "collection factor" was suggested to the writer by Dr. M. R. Horne of the University of Cambridge. The collection and distribution factors for each mode of sway are abstracted under the relevant moment symbol at the top of Table III. Changes of moment since the previous correction are multiplied by the relevant collection factor and entered on Table III to be summed in column M_R. The value of M_R with the sign changed is multiplied by the distribution factor and entered on Table II on the line indicated against the entry on Table III.

Line 1 of Table II contains the initial fixed-end moments and line 31 is the summation of lines 1 to 30 to give the state of the moments after six cycles of all types of correction. The largest unbalance left, as calculated after Table III, is +760 lb.-ft. in sway-equation 3. The largest effect of any such unbalance is 0·222 × 680 = 150 lb.-ft. if distributed. This is 1·7 per cent. of the maximum moment in the frame.

It should be noted that convergence was considerably slower when an alternative sway to mode 2 was chosen, in which only D moved horizontally equivalent to (2)−(1)−(3). For the purposes of an example, a reasonably rapid convergence was required without the use of special devices which would obscure the point it was desired to illustrate, so it was decided to re-cast the calculation in the form given.

A technique containing elements from references 2 (*a*), (*b*) and (*c*) was taught to the writer by Professor A. J. Ockleston of the University of the Witwatersrand, South Africa. Table II follows the practice recommended by him.

REFERENCES.

[1] Hardy Cross. "Analysis of Continuous Frames by Distributing Fixed-end Moments." *Trans. Am. Soc. C.E.*, Vol. 96, page 1 (1932).

[2] (*a*) Grinter, L. E. Discussion of (1). *Trans. Am. Soc. C.E.*, Vol. 96, page 18 (1932).

(*b*) Morris, C. T. Discussion of (1). *Trans. Am. Soc. C.E.*, Vol. 96, page 66 (1932).

(*c*) Matheson, J. L. "The Problem of Sway in Complicated Frames." *Jour. Inst. C.E.*, Vol. 24, page 99 (1945).

[3] Neal, B. G. Discussion on "A Moment Distribution Method for the Analysis and Design of Structures by the Plastic Theory," by M. R. Horne. *Proc. Inst. C.E.*, Part III, page 81 (1954).

APPENDIX

In general, simple moment balance at j joints in a structure containing b members with p pinned ends and r redundancies will leave $2b-r-j-p$ independent equations of statics unsatisfied. This will also represent the number of sway corrections to be sought, but it breaks down in two special cases:—

(*a*) The triangulated structure which is redundant with respect to primary forces in which case r must be diminished by the number of redundant primary forces.

(*b*) The joint which is connected to abutments by two members having their axes in the same straight line, in which case one sway correction must be added.

Both cases arise from the assumptions involved in writing one moment at each unpinned end of a member as the unknown forces in an analysis. Note that (*a*) is trivial, because triangulated structures do not normally involve sway corrections. It arises because the setting out of a moment distribution assumes that all axial forces are known. Case (*b*) however may be of practical significance. The position of a joint connected to abutments by two members is normally defined by the lengths of the members. This breaks down where the two members become in effect a continuous beam and their intersection is badly conditioned. By the addition of one sway correction the dependence of the position of the joint on bending is recognised.

In the example considered $b = 7$, $j = 5$, $p = 1$ and $r = 5$. Therefore the number of independent sways = 3.

Institution of Naval Architects Spring Meeting (*continued from page* 402)

HULL RESISTANCE OF HARBOUR CRAFT

The third paper presented at the Spring Meeting of the Institution of Naval Architects was delivered at the morning session on March 21 by Mr. H. H. Hagan, O.B.E., and consisted of "A Survey of Dredges and other Harbour Craft."

DREDGING CRAFT

Mr. Hagan's paper was general in character, as the title indicated, and necessarily so because of the wide variety of craft covered; the series of outline diagrams which constituted his Table I showed 12 types of dredger as well as seven other craft. In each case he pointed out the principal characteristics and the kind of work for which the type was best suited, together with any special considerations which might have to be taken into account in the design for other than dredging reasons; for example, the distance and the sea conditions between the dredging point and the dumping ground, or the need to make a long sea voyage from the builders' yard and the place of delivery. An interesting instance of the practical details that the designer must consider was that of hopper barges built recently to carry the ash of pulverised coal from power stations for dumping at sea; such vessels, Mr. Hagan pointed out, when loaded with the dry and therefore light ash, would float high in the water at the beginning of the voyage, but they must be designed with sufficient freeboard to carry the ash when fully saturated, as it might become during the voyage by rain and spray falling into the open hopper and by seepage of water through the hopper doors. Many of the naval architectural problems associated with dredges and other harbour craft were difficult in comparison with the design of normal passenger or cargo vessels. Because of their abnormal forms, horse-power could seldom be estimated by reference to any standard resistance series. A certain amount of systematic tank experiment work with dredge models had been done recently by the British Shipbuilding Research Association, and it seemed likely that some of the work carried out with models of coasters might be useful to the designers of harbour craft. Mr. Hagan hoped that a standard resistance series for tugs would become available in the not too distant future.

In addition to the numerous lantern slides, the paper was further illustrated by a film showing various types of dredges with their attendant hopper barges and sludge vessels, and a rockbreaker, in operation.

The discussion was opened by Mr. A. Lederer, who expressed surprise that the author submitted as a typical harbour tug a vessel with a steam engine; all the modern harbour tugs were propelled by Diesel engines. His own preference for a harbour tug was one fitted with the Kort nozzle, which was applicable also to self-propelled hopper barges. The Voith-Schneider propeller was of interest for self-propelled floating cranes, giving manoeuvrability of a very high order. A recent application of the Voith-Schneider propeller was in the "hydrotractor," a tug having one or two such propellers under the hull at a third of the length from the stern. It was being used in European and African harbours very successfully.

Professor A. M. Robb commented that, while the author had given sketches of dredges with a bow well, a centre well and a stern well, he had not shown any with a diagonal well. He had seen one such, built by Mr. Hagan's firm, many years before; it was intended to get into the corners of a dock. He wondered whether the job could not have been done as well with a grab dredge. With reference to the hopper for taking away the ash from a power station using pulverised fuel, he asked whether there was any difficulty in getting rid of the substance from the hopper.

Mr. J. F. Petree asked whether anything had been done in the way of lining chutes and pipes with rubber, and whether it was worth doing.

Mr. O. Hurst said that, having the responsibility of issuing freeboard certificates to ships, he was concerned about the conditions which should be essential on dredges which made long voyages overseas. Usually, a freeboard certificate was issued while a dredge was in the area of its dredging service, but that certificate did not apply to an overseas voyage. Special consideration was necessary in the latter case, including the assessment of stability, and he would appreciate the author's advice on a suitable standard of stability for an overseas voyage and on the precautions to be taken. His own practice was to make a calculation of freeboard on the basis of an ordinary ship, and then deduct the loss of reserve buoyancy due to the presence of a well. There was a Ministry of Transport standard method for calculating free-

board which, he believed, had never been published, and he thought it would be permissible, and interesting, for Mr. Hagan to include it in his paper.

Mr. Hagan, in reply to Mr. Lederer, explained that the tug shown in the paper was used in a harbour overseas, where all the tugs were propelled by steam. The country concerned was largely agricultural, and the choice of machinery was largely influenced by that fact. The use of the Kort nozzle was obviously ideal if the conditions were right. With reference to Professor Robb's mention of diagonal wells: the craft described were only the main basic types. There were all sorts of mixtures, and the records of 60, 70, 80 and 90 years ago showed that most things had been done before. With regard to getting rid of pulverised-fuel ash, there was practically one large opening. The authorities would not allow the ash to be dumped anywhere near the coast, and it had to be taken 15 or 20 miles out to sea.

He would try to obtain the answer to Mr. Petree's question. In reply to Mr. Hurst: the free-board on normal bucket dredges was not designed only for the conditions under which they worked in a harbour, but for the conditions that prevailed during a voyage. Voyage preparation involved taking off all the buckets, loading the ladders and shutting down everything. They would not let such vessels go to sea without a range of 40 to 45 deg. They had not lost one in his time, but he believed that about 30 years ago one was lost.

SHIPBORNE WAVE RECORDER

The fourth paper presented was delivered by Mr. M. J. Tucker, B.Sc., of the National Institute of Oceanography, Wormley, Surrey, who described " A Shipborne Wave Recorder " which had been developed at the Institute.

The instrument described was designed to measure waves from a ship at sea by combining measurements of the sea pressure at a point on the ship's side with the vertical displacement of that point, obtained by double integration of the output of a vertical accelerometer. The method was to measure the height of the water surface relative to a point on the ship's hull and to add to it the height of the point in relation to an imaginary reference surface below the hull. It was not possible to measure the absolute height of the wave-measuring device, but in practice all that was necessary was to measure fluctuations in the height. The effect of reflection of the wave from the hull was overcome by mounting a measuring unit on each side of the ship and taking the mean of their readings, the outputs being electrical and brought to a computing circuit. Generally, the ship must be hove-to when the recorder was in use.

The pressure meter was connected with the sea through a $\frac{1}{2}$ in. hole drilled through the shell plating. An oil-filled chamber was separated from the sea water by a diaphragm of soft rubber, the oil taking up the pressure of the sea water and applying it to the outside of a metal bellows, the inside of which was open to the atmosphere. The resulting deflection of the bellows was controlled by a spring and measured by a mechano-electric transducer. The accelerometer consisted of a weight hung on a spring and attached to the transducer. The system was prevented from moving sideways or rotating by means of two spiral diaphragms, and the whole device was filled with transformer oil, which gave approximately critical damping. The natural frequency of the weight on the spring (including the effect of the inertia of the oil) was about 4 cycles per second, and for wave frequencies, therefore, the device would measure accelerations. It gave full deflection for an acceleration of between 0·4 and 0·5 g.; a wave of 24 seconds period (the longest ever encountered in the North Atlantic) and with an amplitude of 1 ft. produced only about 10^{-3} g. It was stated that an instrument of the type described had been in service for more than two years, during which time several thousands of records were taken, and it had proved to be reliable.

The discussion was opened by Dr. J. F. Allan, who said that the instrument sounded almost too good to be true; it was something which, for a long time, they had all wanted. The state of the sea round a ship was obviously of great importance to naval architects, and the usual description in a ship's log was usually treated with some reserve. To estimate the general condition of a sea was almost impossible. There had been previous methods, based on photographic work, but the analysis of their records was an extremely laborious process. The author had stated that the accuracy was reasonably high over the main range of waves, and had indicated that some checks had been made. Against what standard had he checked that accuracy? If the accuracy claimed was acceptable and was proved, the instrument should be quite adequate for the purposes of naval architects. Was it possible to correct for the wave system created by the ship at sea? Could the instrument be used successfully at full speed on an ordinary merchant ship? If not, its use was limited. Could the author give some indication of its cost and the skill required in its operation? The development of the instrument at the present time was particularly opportune, because the interest on the research side in the behaviour of ships at sea was increasing and, in his opinion, it would become a major research interest.

Mr. D. E. Cartwright, who wrote the appendix to Mr. Tucker's paper describing the method of applying the recorder to the study of ship motions at sea, said that, at the National Institute of Oceanography, they had improved enormously on previous methods; with a spectral analyser they could analyse sea waves very accurately, and it was thought likely that ship motion could be subjected to the same type of analytical technique. Therefore, they measured ship motions in conjunction with the wave recorder. In the past, the study of ship motion had been confined almost entirely to theoretical calculation, and measurements of the motion of models in regular waves in tanks. There had been a number of ship motion measurements, some very accurate, but their value was limited unless the waves could be measured as well. They measured the waves first by steering a ship at about 7 knots in various directions, observing the motion of the ship as they measured the wave. They could study the directionality in the waves, provided that they were fairly simple. Having analysed the waves, they also analysed the ship motion and compared the two, using a linear theory by the superposition of linear equations.

The results were rather encouraging. There had been a large number of experiments in tanks, and theoretical work, which indicated that a linear theory was not very far wrong. On one occasion when the ship was steered in different directions it was found that, when the waves were coming from behind the ship, they seemed much reduced; that did not appear on subsequent occasions. It was not clear whether that effect was due to a fault in the recorder or to a fundamental attenuation of waves coming from behind the ship, due to turbulence arising from the propeller race, or the possibility of the pressure being reduced due to surging. Neither of those theories had produced any definite conclusions. On the whole, within the limits claimed by Mr. Tucker, of the order of 10 per cent., the ship motions seemed to confirm the accuracy of the instrument at a speed of about 7 knots. He was not prepared to say what would happen at 15 or 20 knots.

Mr. A. J. Williams welcomed the paper because it brought the full mathematical and scientific resources of the oceanographer to the assistance of the naval architect in the field of ship motions. It showed that, with the installation described, waves of period less than about 6 seconds—i.e., of length less than about 180 ft.—could not be measured with accuracy. While that limitation was probably acceptable for open ocean locations, there were some areas, such as the North Sea, in which waves of that length would be of considerable importance. The limitation appeared to be, to some extent, a function of the size of the ship carrying the recorder. Could the author say whether mounting the instrument in a smaller vessel would significantly increase its range for use in coastal and sheltered waters ?

The instrument had the great advantage that it enabled ship and wave motion records to be obtained simultaneously, and directly correlated; but it appeared to have the inherent disadvantages that, the record having been obtained, weeks of work must be faced before any results were available. Was effort being devoted to producing some form of automatic analyser for use while the record was being made ?

Mr. J. H. B. Chapman asked what use practical naval architects would make of the information when they had it. In the Admiralty, they had recently approached the problem from the other direction. What they wanted to know was how much the ship moved, what happened to it, and what sort of motions they had to contend with. Therefore they had been developing two different types of instrument. One was a statistical recorder which could be put into a ship to record its motions over any period, rolling or pitching, and which would show how many of those movements exceeded certain pre-set figures; it would give a complete analysis of the number of rolls exceeding 2 deg., 3 deg., 5 deg., etc. That instrument, it was hoped, could be put into a ship and left there, to be started by the ships' officers whenever they wanted to take records. The other instrument was for measuring the vertical motion at any particular part of a ship. On aircraft carriers the motion of the flight deck was of very great significance, and that instrument, if successful, would give that information.

Mr. Tucker, in reply to the discussion, said that the instrument had been used by Mr. Cartwright in measuring waves directly, modifying the wave period when the ship was moving. Obviously, if the ship was steaming into the waves, they were met at a rate faster than their true period; when steaming with the waves, they were encountered more slowly. There was the exceptional case of steaming away from waves at exactly the same speed as they travelled, when false records of wave period would be obtained unless a correction could be made for the direction of approach of the waves.

In reply to Dr. Allan: the cost of the instrument was about £1,600. It had to be made very carefully, so that it involved a lot of expense. It seemed to be reasonably reliable; the one in the weather ship had gone wrong only three times in three years, and it was in use eight times a day. No skill was required to operate it; the operator had merely to switch on and watch the wave record come out.

About the discrepancy mentioned by Mr. Williams: he had said that the instrument was reliable only for waves of 200 ft. length or more, but it would measure a wave of 100 ft. Much depended on the size of the ship; the instrument would, in fact, measure wave patterns of four seconds period, or even less in the smaller ships. For automatically analysing the waves when the records came out of the instrument, they had connected a device which gave the root mean square of the wave height. If the highest wave in a 10 minute wave record were measured, it was surprisingly good as a measure of any of the main wave types.

The report of the meeting will be continued

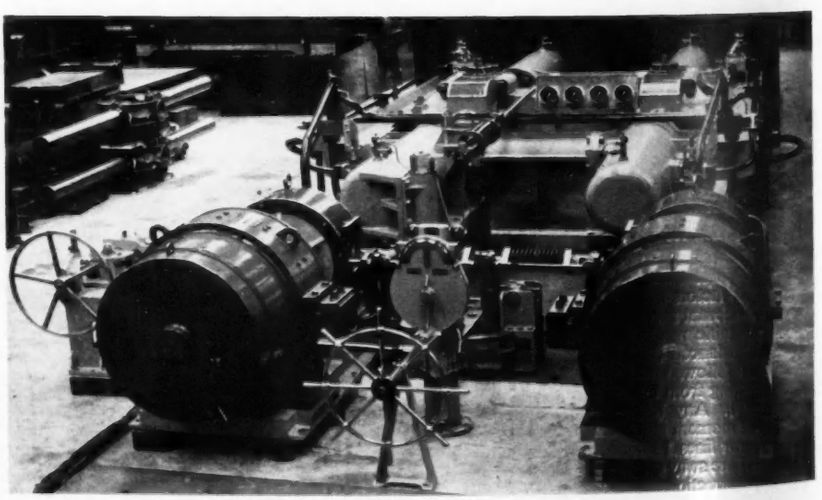


Fig. 1 Electric-hydraulic marine steering gear. John Hastie and Company of Greenock have been making ships' steering gears since 1845 and now produce both electric-hydraulic and steam-hydraulic gears for merchant and naval vessels. [For text, see opposite

ENGINEERING IN SCOTLAND—1

Two factors have played a major part in the growth of industry in Scotland: the presence of a large navigable river, the Clyde, and the occurrence of extensive coal deposits. For this reason many Scottish industries have their origins either in shipbuilding or in coal mining. Thus shipbuilding has given rise to such associated activities as the making of ships' steering gear, boilers and marine valves; and coal mining to the production of flame-proof switchgear and cable-winding machinery, while both primary industries have links with wire-rope making. Other resources have of course also contributed to Scottish industrial development, and not the least of these are farming in the Lowlands and hydro-electric power in the Highlands—one an ancient industry the other relatively new—which have led respectively to the manufacture of such items as agricultural implements and earth-moving equipment. In the present series of articles we shall outline the history and describe the products of some Scottish firms selected at random, hoping that by so doing, we may give a cross-section of current engineering activity in Scotland. (See Weekly Survey.)

SHIPS' STEERING GEAR

Since 1845, when the firm was first established, John Hastie and Company, Limited, of Greenock have been making steering gear for ships. During the course of more than a century they have contributed to developments in this field, and to-day they are building electric-hydraulic (Fig. 1) and steam-hydraulic gear for both naval and merchant vessels. An important factor in the evolution of marine steering gear was the introduction of the "Hele-Shaw" variable-delivery pump which is a feature of both the electrically and steam operated versions. The present article includes descriptions of the equipment and a short account of the company's history.

In its early years, the company produced the right and left hand screw gear which was widely used until recently, but in the 70's they also started to make steam steering gear. For many years this was a chain gear but in 1900, the "Wilson-Pirrie," system was adopted. In 1910 they introduced the electric-hydraulic steering gear and were for a long time its sole makers. In 1911, Hasties made the steering gear for the Danish East Asiatic Company's vessel, the Selandia, which was built by Burmeister and Wain and was the first ocean-going Diesel ship; the steering gear was entirely successful.

Following the first World War, during which the company produced numerous units for both merchant vessels and warships, they developed, in 1934, the steam-hydraulic steering gear. The first ship to be so fitted was the Anglo-Saxon Petroleum Company's (now Shell Tankers) vessel "Ancylus," which was built by Swan Hunter of Wallsend and ran her trials in January, 1935. Steam-hydraulic gear has been used extensively during the last 20 years and been fitted in all classes of vessel.

In 1937 the company considerably extended their premises, almost doubling them in size, and during the years immediately preceding the second World War installed much new plant; they were thus well equipped to meet war-time requirements. Steering gears were built for every class of naval vessel—submarines, frigates, destroyers, cruisers and aircraft carriers—and, in 1946, Hasties made the gear for H.M.S. Vanguard and later for H.M.S. Eagle. Gear was also produced for merchant ships, and since then vessels built in many European countries and elsewhere have been fitted with Hastie equipment.

VARIABLE-DELIVERY PUMP

Before the working of the steering gear itself is described it is necessary to explain the Hele-Shaw principle employed in the Hastie variable-delivery pump, the main features of which are shown in Fig. 2. The pump consists of a case A to which are attached two covers, the shaft cover B and the pipe-connection cover C. The latter cover carries the tube D (or central valve) which has ports E and F forming the connections between the cylinders and branches G and H. The cylinder body J is driven by shaft K, and revolves on tube D, being supported at each end by ball bearings T.

The pistons L are fitted in a row of radial cylinders and through the outer end of each piston is inserted a gudgeon pin M, which attaches the "slippers" N to the piston. The slippers are free to oscillate on their gudgeon pins and fit into tracks in the circular floating ring O. This ring is free to rotate, being mounted in ball bearings P, which are housed in guide blocks R. The latter bear on tracks formed on the covers B and C and are controlled in their movements by spindles S, which pass through the pump case A. The maximum pump stroke is fixed by the guide-block ends coming in contact with the casing. Further restriction of the pump stroke is effected externally.

The pump is of rotary plunger pattern. Fig. 3 shows sections through the tube D, cylinder body, pistons and slippers at right angles to the axis. X Y is the line along which stroke variations take place; the arrow indicates the direction of rotation. With the floating ring central, that is concentric with the tube D, the slippers move round in a circle concentric with D, and consequently no pumping takes place (Fig. 3*a*). With the floating ring moved to the left, the slippers rotate in a path eccentric to tube D and the cylinders; consequently the pistons as they pass above the line X Y recede from D and draw oil through the ports E, while the pistons below X Y approach D and discharge oil through ports F (Fig. 3*b*). With the floating ring moved to the right the reverse action takes

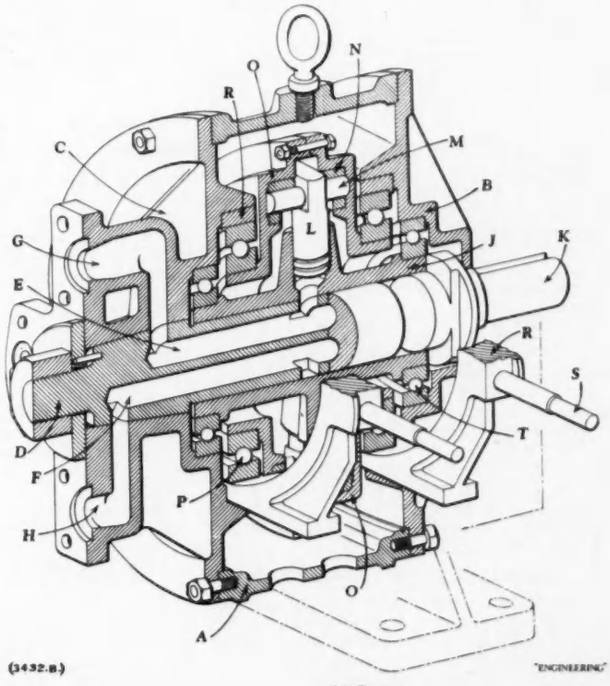
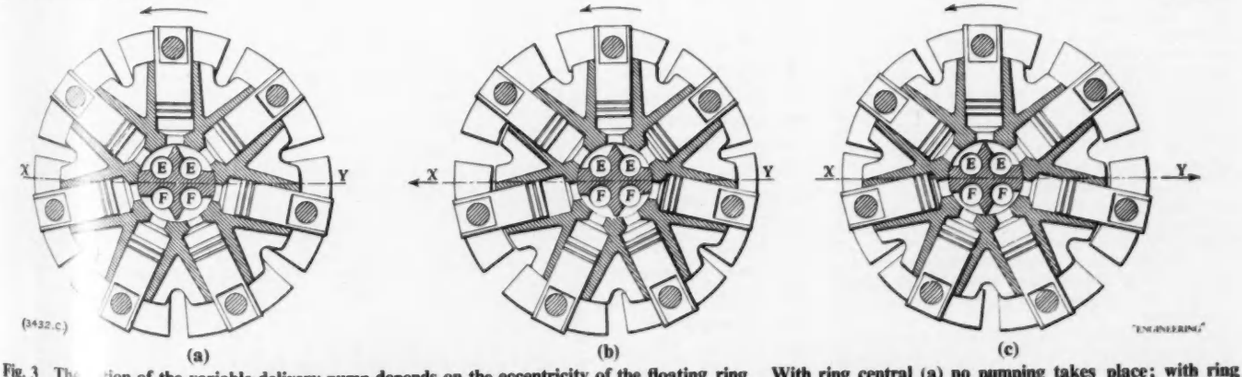


Fig. 2 Hastie variable-delivery hydraulic pump which employs the Hele-Shaw rotary-plunger principle. Although rotation of the pump is constant and in one direction only, delivery can be varied or reversed by displacement of a floating ring (O).



(a) (b) (c)

Fig. 3 The action of the variable-delivery pump depends on the eccentricity of the floating ring. With ring central (a) no pumping takes place; with ring moved to the left (b) the pistons draw oil through ports E and discharge oil through ports F; with ring moved to the right (c) the reverse action occurs.

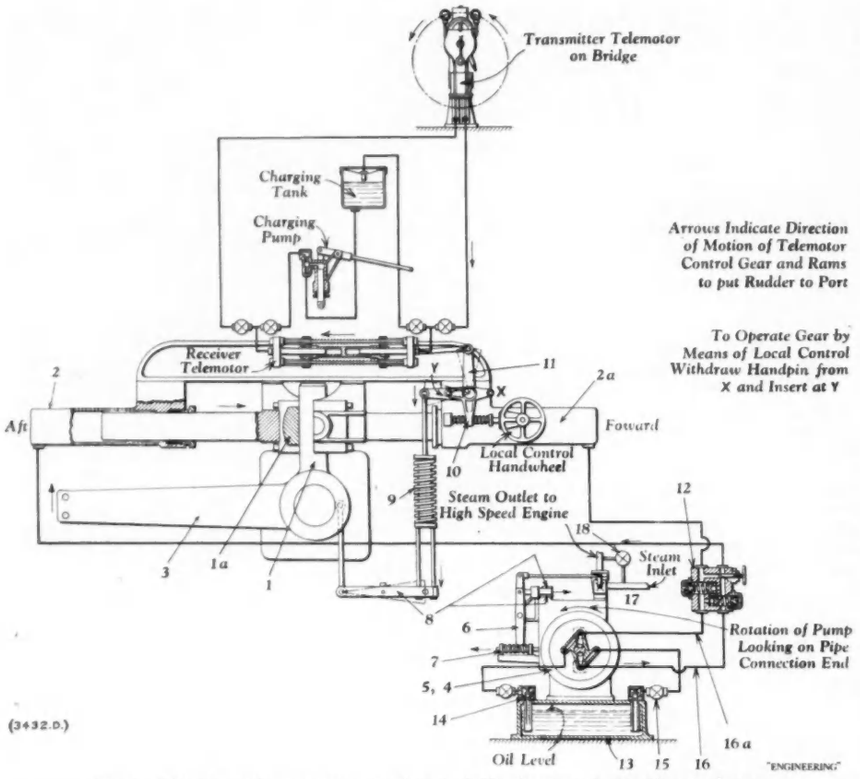

Transmitter Telemotor on Bridge
Charging Tank
Charging Pump
Arrows Indicate Direction of Motion of Telemotor Control Gear and Rams to put Rudder to Port
To Operate Gear by Means of Local Control Withdraw Handpin from X and Insert at Y
Receiver Telemotor
Aft
Forward
Local Control Handwheel
Steam Outlet to High Speed Engine
Steam Inlet
Rotation of Pump Looking on Pipe Connection End
Oil Level
(3432.D.)
"ENGINEERING"

Fig. 4 Diagrammatic arrangement of typical Hastie steam-hydraulic steering gear.

1. Tiller fixed to rudderstock.
1*a*. Emergency tiller.
2. Aft cylinder and ram.
2*a*. Forward cylinder and ram.
3. Swivel crosshead.
4. Variable delivery pump.
5. High-speed engine.
6. Lever transmitting push or pull of floating lever to pump control gear; it also operates the steam control valve.
7. Pump spring control gear.
8. Floating lever.
9. Spring link.
10. Lever for setting pump on stroke when steering by local control.
11. Lever for setting pump on stroke when steering by telemotor.
12. Shock and by-pass valve.
13. Replenishing tank embodied in sole-plate under pump and into which leakage from pump is bled.
14. Suction replenishing valve.
15. Suction replenishing shut-off valve.
16. Pipe to aft cylinder (2).
16*a*. Pipe to forward cylinder (2*a*).
17. Steam control valve.
18. Pilot by-pass valve.

place; the lower pistons move outwards drawing oil through ports F, and the upper pistons move into the cylinders discharging oil through ports E (Fig. 3*c*). The flow of oil is therefore reversed without altering the direction of rotation of the pump.

The direction of flow depends on the location of the floating ring, left or right of centre. The floating ring can be moved to any intermediate position between the central and maximum positions, and the quantity of oil discharged varies according to its displacement from the mid-position.

STEAM-HYDRAULIC GEAR

The steam-hydraulic gear consists basically of single-acting rams working in cylinders. The rams are arranged to operate the tiller, which is keyed to the rudderstock, through swivel cross-heads. Oil for operating the rams is supplied by a variable-delivery pump of the type already described driven by a high-speed double-acting (enclosed force-lubricated) steam engine. The gear is so designed that with the vessel going full ahead it is capable of putting the rudder from hard-over to hard-over in 30 seconds. Complete control is obtained by rotating the steering wheel of the transmitter telemotor on the bridge.

The control valve of the steam engine is also operated from the navigating position and is so arranged that when the rudder is at its normal setting the engine continues to turn over slowly. Movement of the steering wheel opens the valve, thus admitting more steam to the engine. In this way a maximum economy in steam usage is achieved.

A diagrammatic arrangement of the steering gear is shown in Fig. 4. Rotation of the steering wheel displaces fluid and causes movement of the receiver telemotor, which is transmitted through lever 11 and spring link 9 to floating lever 8, and hence the pump is pushed or pulled on stroke. Oil is then delivered through either pipe 16 or pipe 16*a* moving either ram 2 or 2*a*, together with swivel crosshead 3.

The floating lever 8 is designed to hunt in such a way that the pump is brought to the "no delivery" position when the desired rudder angle has been obtained. The centre of the floating lever is mechanically connected with lever 6 and pump spring control gear 7, and the displacement of this point governs the discharge of the pump and also the control valve admitting steam to the engine.

To return the rudder to amidships, the pump is set to the reverse stroke by rotating the steering wheel in the opposite direction until it reaches the midships position, and as the rudder approaches this point it is hunted off stroke, as previously noted. Should the rudder be displaced by an external load, such as a heavy sea, the pump will be put on stroke in the direction which causes it to correct the rudder displacement.

The electric-hydraulic steering gear is fundamentally similar to the steam system except that the variable-delivery pump is driven continuously by an electric motor. Economy in power consumption in this case arises of course from the variation in current demand as the load changes.

HEAVY-DUTY VALVES

Weir Valves Limited was established in 1951 when the parent company, G. and J. Weir Limited, Cathcart, Glasgow, were requiring room for expansion. It was decided at that time to transfer the production of valves to a new factory on Queenslie Industrial Estate. The works now occupies 132,000 sq. ft. and employs over 400 people, all engaged in the production of valves; these are made either in accordance with the specifications of the parent company for use with the auxiliaries built by them, or to meet general requirements. In particular, Weir Valves Limited have developed a technique by which the seats of globe or parallel slide valves, intended for steam pressures of 600 lb. per square inch and over, may be given a hard facing. The factory, which has been built to permit the ready application of modern production methods, incorporates heat-treatment plant, and a variety of inspection equipment including gamma-ray and hardness testing apparatus, by means of which rigid quality control is maintained.

Modern power stations and other forms of steam-raising plant tend increasingly towards the use of higher temperatures and pressures, with the consequence that valves are subject to more and more onerous operating conditions. Extensive experiments were carried out at the Queenslie works to produce a valve capable of high efficiency in the upper ranges of steam pressure, and free from the general tendency for leakage to occur at the junction between seat and body—a common fault where seats are pressed or screwed home. The advantage of the renewable seat was thus largely offset by this defect.

The result of the investigation was a range of forged-steel globe-type stop valves, suitable for use in high-pressure steam and drain lines in both marine and land applications. They have been

Fig. 5 To overcome the tendency for leakage to occur in valves subject to high pressures and temperatures, Weir Valves Limited have developed a technique known as "hard facing" whereby Stellite is deposited on the valve body by welding, thus forming a durable seat. The technique has been used both for globe valves and for parallel-slide valves.

Fig. 6 Finished valve seat after hard facing. The Stellite seat is very tough and hard and generally proof against erosion and corrosion.

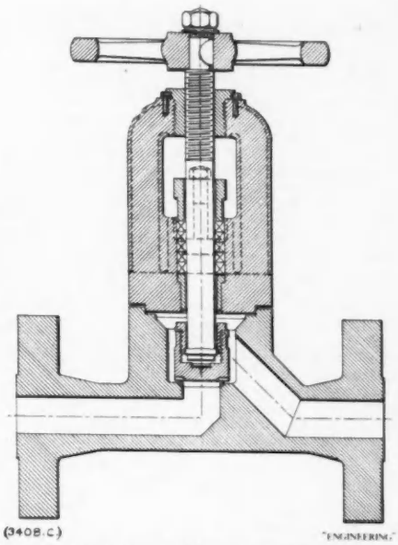


Fig. 7 Hard-faced globe valve with ratings of 900 lb. per sq. in. and 800 deg. F. (steam), and 1,400 lb. per sq. in. and 450 deg. F. (water).

designed to operate with steam pressure ranging up to 600 or 900 lb. per square inch and temperatures well over 800 deg. F.; and oil or water pressures up to 1,400 lb. per square inch and temperatures up to 450 deg. F. The valves are made in a wide range of sizes, including ½ in., ¾ in., 1 in., 1¼ in., 1½ in. and 2 in.; with flanges drilled to B.S. tables " R " and " S."

HARD FACING

The principal feature of these valves is the nature of the seat, which embodies a hard face consisting of Stellite deposited on the body by welding and then machined to give a smooth plane surface. The welding operation is shown being carried out in Fig. 1 and a finished seat can be seen in Fig. 2. The mating surface of the valve head is similarly treated. The deposited Stellite is extremely tough and hard, having a Brinell hardness number of about 400, and it is generally proof against erosion and corrosion.

The valve head on which the hard face is deposited is made from stainless steel, as is the valve spindle, which is centreless ground to a fine finish. Glands and bushes are made from high-quality bronze. The valve body and cover are machined from solid steel forgings. There are two principal ranges, for steam pressures up to 600 and 900 lb. per square inch respectively; the general design of the latter is shown in Fig. 3, on page 461.

A similar hard-facing method has been adopted for high-pressure parallel slide valves. An 8 in. valve of this pattern has been installed in Braehead power station and operates at 950 lb. per square inch and 925 deg. F.; it was previously tested up to 2,000 lb. per square inch. Parallel slide valves of smaller bore have been fitted on final superheater drains, and others are in service at power stations and in marine installations.

Other products of the Weir Valves factory include stop valves in cast iron, malleable iron and forged steel for pressures up to 350 lb. per square inch (forged steel), the cast-iron models being of right-angled pattern; screw-down non-return valves in the same materials; and cast-steel exhaust valves with spindle, discs and wedge in stainless steel and seats in nickel alloy. Weir Valves Limited are situated at 95 Coltness-street, Queenslie Industrial Estate, Glasgow, E.3.

Further articles in this series will be published later.

The Iron and Steel Institute Spring Meeting

ACID-BESSEMER PROCESS, INGOT HEATING AND SOLIDIFICATION

The eighty-seventh annual general meeting of the Iron and Steel Institute was held in London from May 15 to 17. On the evening of the first day Mr. James Mitchell delivered a Bessemer Centenary Lecture and this was reviewed on page 389 of our issue of May 25. The morning of the second day, May 16, was devoted to the transaction of official business, after which the newly-installed President, Dr. H. H. Burton, C.B.E., delivered his presidential address, which was also dealt with on page 389 *ante*.

The remainder of the meeting was devoted to the presentation and discussion of technical papers which commenced after the luncheon interval on Wednesday, May 16.

THE ACID-BESSEMER PROCESS

The two papers presented on Wednesday afternoon both dealt with phases of the Acid-Bessemer process of steel manufacture. The first, on " The History and Practice of the Acid-Bessemer Steelmaking Process in West Cumberland," was by Mr. F. B. Cawley and Mr. D. R. Wattleworth of the Workington Iron and Steel Company. These authors stated that steelmaking in the West Cumberland district had begun in 1872 when four 7½ ton converters had been installed, and the manufacture of steel rails, for which a world-wide demand had arisen, commenced. Called to the management of the new Bessemer shop, of the West Cumberland Iron and Steel Company, in that year, was George James Snelus, who was then 35 years of age. A few months later he had been appointed general manager of the entire works. The steel rails produced had gone all over the world and had played no small part in the building of the transcontinental railways of the United States and Canada.

The next steelmaking plant to be laid down in the area was a Bessemer shop, consisting of three 8 ton converters, together with a rail rolling mill at Moss Bay, Workington, in 1877.

During the past 30 years, the proportion of low-manganese local ores in the burden of the blast furnaces of the works had shown a steady decline. More and more dependence on supplies from overseas had resulted in a change in the type of iron produced for conversion. The tendency had been for manganese to go up and silicon to come down. The change to a higher-manganese iron, i.e., from 0·60 to 0·80 Mn in the 1920's to 1·00 to 1·30 at the present time, had brought some serious steelmaking problems in its train. Eventually, it had been found that the most satisfactory method of meeting the position was to turn down the converter before the normal end-point and before any considerable quantity of FeO had been generated. Under these conditions, the concentration of FeO in the metal was very low and something approaching a neutral slag was produced. This fulfilled all the conditions required for good steelmaking practice, namely, a low degree of oxidation of the metal, the minimum wastage of manganese from deoxidising additions, and a neutral slag covering for the steel in the ladle.

This practice, however, could not be followed in the case of mild steels as the carbon would be too high. When making such steels, therefore, it was necessary to blow to the second drop in the flame. The converter was then turned down, the bulk of the slag decanted, and the finishing addition of ferromanganese added. By the time this was done, the small quantity of slag remaining on the metal had stiffened up considerably and was less reactive.

The swing from low to high-manganese iron, which had been regarded initially as an unmitigated evil, had led ultimately to a better understanding of the process and had opened the door to a new field of possibilities in the direction of exercising beneficial control over the quality of the product.

The second paper was entitled " Control in the Acid-Bessemer Process, Application of the Volume Debitgraphe, Opacimeter, and Flame Pyrometer." It was by Mr. P. J. Leroy and Mr. J. G. Galey, of the Institut de Recherches de la Sidérurgie (IRSID), and Mr. F. B. Cawley, of the Workington Iron and Steel Company. The paper described instruments, developed by IRSID for studying the French basic-Bessemer process, which instruments had been installed for trial purposes at the acid-Bessemer plant of the Workington Iron and Steel Company.

The authors stated that the volume Debitgraphe was a flow-meter which continuously recorded the rate at which air was blown into the converter, expressed in cub. ft. per minute at N.T.P. The opacimeter depended on the passage of light from a constant source through the converter flame on to a photo-electric cell, the cell current being amplified and recorded as a measure of opacity. In the flame pyrometer, a photo-electric pyrometer was sighted through the converter flame at a tungsten ribbon lamp, thereby receiving light energy from the flame itself as well as part of that emitted by the lamp. A second pyrometer was sighted on the tungsten lamp only and was not affected directly by the flame. It could be shown that when both pyrometers registered the same, the brightness temperature of the lamp equalled the true temperature of the flame. It followed that true flame temperature could be measured from the tungsten lamp, provided that means were available for automatically adjusting its brightness to give identical values on the two pyrometers. In the new instrument this was achieved through a servo-motor.

Preliminary tests had provided new information on the factors affecting air consumption per ton of iron, notably the influence of bath depth, blowing rate, and the silicon content of the iron, and they had indicated how blocking of the tuyeres could be detected from permeability measurements, how opacity measurements could be used to give an end-point signal, and finally they had indicated the possibilities of simplifying and bringing refinement to the estimation of temperature at a sufficiently early stage in blowing to permit the proper assessment of the scrap or ferrosilicon needed so that the blow would finish within the desired temperature range.

Mr. F. B. Cawley presented the first paper, and Mr. P. J. Leroy the second. Mr. D. R. Wattleworth added that the fact that the process had been continuously operated at one works in West Cumberland for 79 years must be something of a record for an industrial activity. He reckoned that, at Workington during that time, not less than 20,000,000 tons of Bessemer steel had been made and this had gone all over the world. It so happened that at present an apprentice training school for the training of craft apprentices was being built at Workington and it had been decided to call it the Bessemer Memorial School. Her Majesty The Queen had graciously consented to open it in October of this year.

A colour film entitled " Steel Road " was then shown. It contained pictures of some of Sir Henry Bessemer's inventions, some scenes from Workington and views of the mines and works at Workington where the acid-Bessemer process is carried out.

DISCUSSION

Mr. John Glen, who was the only speaker in the discussion, said that it had been stated that the French converters normally worked with a metal depth of from 2 ft. 4 in. to 3 ft. on new linings, but

the tonnage was not stated. At Corby a 2 ft. 6 in. bath was used for the start of the first bottom, with a 26 ton charge, but this was not the normal weight; the normal weight was 22 tons for a first bottom and the bath depth was about 26 in. The bath depth grew as the bottom wore.

On the question of "slopping," practical observations and experience showed that there was a certain bath level for any given temperature and composition at which the blast was effectively and fully used. At greater bath depths there was a pulsating effect and the pressure built up to a peak, which caused eruption and the blowing out of large pieces of material; then the cycle was repeated.

Reference had been made in the acid process to the Si : Mn ratio. In basic practice, when the manganese exceeded the silicon, slopping conditions were improved. In the FeO-MnO-SiO ternary diagram there was a low-viscosity trough at 1,200-1,250 deg. C.; this occurred at 50 to 60 per cent. MnO. In the basic converter at this time the slag was predominantly acid; there was little of it and what there was coated the solid unchanged pieces of lime. If the manganese exceeded the silicon in the iron sufficiently to form this very fluid type of slag, it was reasonable that the converter should take air more readily and blow more easily. Also, possibly, when the silicon exceeded the manganese, especially when the concentration was high, free silicon, which was probably solid at that temperature, was formed and was suspended in the metal. This increased the resistance to the blast. The blast pressures at Workington were lower than at Corby. At the latter works it stood at 29 to 30 lb. per sq. in. To minimise slopping during the early part of the blow with high-silicon iron it was usually necessary to reduce this full blast, for a short period, to 25 lb. per sq. in.

Flame pyrometer temperature control was probably the factor of greatest importance in the whole Bessemer process and it would be beneficial if a control which combined both end-point indication and temperature indication were devised. He would like to ask the authors whether the flame pyrometer would work when using oxygen.

After a brief reply from Mr. Cawley, the meeting was adjourned until the following morning.

INGOT-HEAT CONSERVATION

The first two papers considered on the morning of Thursday, May 17, were both communications from the Plant Engineering Division of the British Iron and Steel Research Association, and both dealt with "Ingot-Heat Conservation." The first paper, on "Cooling of 15 ton Ingots Between Teeming and Stripping," was by Mr. L. H. W. Savage and Mr. M. D. Ashton. They stated that the rate of heat loss from the mid-height section of a 15 ton rimming-steel ingot had been determined for 12 casts. This could be represented as a function of time from the start of teeming t, in minutes, and the initial mould temperature θ, in deg. C., by the regression equation: $H_s/\sqrt{t} = a + b\theta + ct + dt^2$, or with slightly greater error by $H_s/\sqrt{t} = k$, where H_s represented the heat loss of the steel in calories per gramme or therms per ton, and a, b, c, d and k were constants, the values of which had been determined. An increase in initial mould temperature caused a decrease in the rate of heat loss. It was possible to determine the initial mould temperature from the time which had elapsed since the mould had been stripped.

By making certain simplifying assumptions, the average thickness of the solidified shell S in cm., or in., could be expressed by the equation: $S = K\sqrt{t}$.

From a limited number of measurements at points other than the mid-height plane, the average heat loss per unit mass of the ingot had been calculated to be about 25 per cent. greater than that at the mid-height section. From the results it was possible to recommend a reduction in standing time between teeming and stripping, which would result in a saving of fuel in soaking pits.

The second paper on "Ingot-Heat Conservation" was by Mr. M. D. Ashton, Mr. R. F. Perkins and Mr. L. H. W. Savage and dealt with "The Cooling of Rimming-steel Ingots between Teeming and Stripping." In this the authors described a method of reducing fuel consumption in soaking pits, increasing pit availability, and increasing mould life by stripping all ingots at the earliest practicable time. The method was based on a series of investigations which had been carried out on 8 and 15 ton rimming-steel ingots, and it had been confirmed that the time from the start of teeming and the initial mould temperature were the most significant factors influencing the heat loss from 15 ton rimming-steel ingots.

A comparison of the results obtained from 15 ton ingots with those from earlier work on 8 ton ingots had shown that increasing ingot size (*a*) decreased the rate of cooling due to a decrease in the ratio of surface area to mass; and (*b*) increased the magnitude of the effect of initial mould temperature.

DISCUSSION

Mr. A. J. K. Honeyman who opened the discussion stated that although the practical application of the results obtained was not so simple as might at first sight appear, knowledge of the cooling characteristics of ingots and the corresponding heating and cooling of the ingot moulds was of considerable value and might lead eventually to new ideas not only in soaking-pit practice but on the problems of mould handling and usage.

Probably the most serious problem affecting soaking-pit practice was bunching. While ingots were normally supplied to the rolling mill at a uniform constant rate throughout the 24 hours of every day, they arrived in the stripper bay in casts of 100 or 200 tons and several casts might arrive within a single hour. This bunching effect made it difficult, if not impossible, to organise the soaking-pit practice on the ideal basis recommended. In some plants bunching, to some extent, could be controlled by giving preference in the melting shops to certain qualities of steel, but where, as in the practice at the Steel Company of Wales, Ltd., the great bulk of the steels were of a similar quality—low-carbon rimming steel—this remedy was not available.

One other point was perhaps worth consideration, namely that normally it was necessary for the ingot surface to be at or near rolling temperature for a certain minimum time to remove surface defects inseparable from normal steelmaking and pitside practice. A saving in soaking-pit time might, therefore, lead to other and possibly more serious troubles.

Mr. N. H. Turner stated that at the Appleby-Frodingham Steel Co., where the general quality of the steel produced had been no appreciable handicap to retaining as much heat as possible in the ingots before charging, the advantages of a short track time had been forcibly brought to the fore following investigations carried out, as far back as 1933, on the cooling and heating of ingots. Compared with the methods used in the two investigations forming the subject of the papers before the meeting, these tests could be considered as only rough and ready. All the same, they had served their purpose and had permitted the investigators to draw some conclusions which were related to the papers under discussion.

It was very well to consider that the minimum time necessary between teeming and stripping was just that required to obtain adequate solidification. The inside of the ingot mould, did not always present a perfectly smooth flat surface and it was necessary to allow also for the shrinkage of the ingot to be such as to permit any asperities which might exist to be of no effect in the withdrawal of the ingot from its mould. The time necessary for that occurrence appeared to be greater than the time necessary for the required solidification.

Another conclusion arrived at at Appleby-Frodingham and which was touched on in the second paper was that it was useless to charge a large ingot into a hot soaking pit as quickly as it could be stripped. Time must be given for cooling to be achieved to the extent necessary to permit the soaking time being a minimum. This could be achieved by deliberately allowing the ingot to remain in the open air after stripping for a length of time related to the time which had elapsed since it had been teemed. In that way such a degree of cooling of the outer surface was obtained that when the ingot was introduced in the hot soaking pit the heating of that part of it to rolling temperature was effected equally by heat obtained from the liquid centre and by heat obtained from the soaking pit proper. To suggest that a similar result could be achieved by having an initial soaking period in the soaking pit with the fuel input reduced was a fallacy.

At Appleby-Frodingham, no 10 ton ingots were charged into the hot soaking pits in less than two hours after teeming. The minimum tap-to-tap time for ingot moulds was eight hours and a reasonable average 12 hours.

In the course of his reply Mr. L. H. W. Savage said that Mr. Turner had raised an important point on the question that the stripping time was dictated by the fact that it might or might not be possible to strip the moulds. This was something which must be considered from the engineering point of view. If, in the national interest, fuel consumption had to be reduced, and this could only be done by earlier stripping, there was something to be said for looking into the features of mould design which would render stripping easier.

SOLIDIFICATION OF STEEL

The last two papers considered at the morning session of Thursday, May 17, both dealt with the effects of various factors on the pouring and solidification of steel. The first was entitled "The Effects of Gravity in the Solidification of Steel," and was by Mr. Basil Gray, of the English Steel Corporation Limited, Sheffield. He described in detail the macro-structures obtained in a series of vertically-cast, bottom-poured steel ingots with different feeding arrangements, and stated that the presence of convection currents had been found to have a powerful effect on the structures obtained. Modifications to the thermal conditions in the feeder heads led to important changes in the mechanism of crystal growth in the solidifying steel. These changes were effective in the earliest stages of freezing and could be caused only by convection currents.

Nuclear and equiaxial dendrite crystals were considered to originate from identical crystallites, and the difference in the shapes was attributed to the differences in the environment in which they grew.

In nearly all the mechanisms proposed in the past a major difficulty had been to explain how the heat of freezing was dissipated in equiaxial formation. It had been found that in vertical castings nearly all such freezing took place in the current at the walls so that the heat was dissipated through them. This explanation also showed why, in nuclear-crystal formation, the columnar wall growth was severely checked.

V-segregates were not caused by the materials being sucked down in the centre of the casting, as was often suggested, but were traces of the natural angle of repose of such loose material. The crystals piled up against the walls of the casting and periodically collapsed across it to the centre.

Variations in the degree of micro-segregation found in different parts of the ingots were found to be caused by convection.

Dr. A. H. Sully, who opened the discussion, said that apart from the work which the Iron and Steel Institute has fostered over the years on the subject of heterogeneity in steel ingots, the British Steel Castings Research Association and its predecessors in title, the Research and Development Division of the British Steel Founders Association and the Steel Castings Division of the British Iron and Steel Research Association, had for some years carried out investigations on the solidification of steel castings. In some of this work, notably that of Mr. J. A. Reynolds—referred to by Mr. Gray—the importance of convection had been demonstrated and recognised. Mr. Gray, however, had realised the full significance of convective movements of liquid streams in modifying columnar crystal growth and in affecting the growth and collection of nuclear crystals.

Dr. L. Northcott said that to all intents and purposes when explaining crystal structures one could forget about the latent heat of solidification, which was tiny compared with the heat lost by conduction.

EFFECT OF POURING SPEED

After a brief reply from Mr. Gray, the meeting moved on to the next paper on the agenda. This, on "The Effect of Temperature and Pouring Speed on Ingot Structure," was by the Ingots Committee of the British Iron and Steel Research Association, and was introduced by Mr. K. C. Barraclough. The Committee stated that a 5 ton high-frequency melt of low-carbon 3 per cent. nickel 1 per cent. chromium steel had been tapped in two halves, with a temperature difference of 40 deg. C. between them; each half had been made to produce two 1 ton ingots which had been cast at different rates. The examination of the ingot surfaces had shown the presence of transverse cracks in the ingot cast the more rapidly at the high temperature, while that cast the more slowly at the lower temperature had exhibited a slaggy surface. Longitudinal sections of the ingots had shown only a small difference in the structures, the length of the columnar crystals in the ingots cast the hotter being, as expected, somewhat longer. The structure revealed by an ammonium persulphate etch, however, could not be accepted as representing the as-cast structure, and it was suggested that it was the result of the peritectic transformation in the particular steel under study. Further work in this connection was being carried out.

Mr. Basil Gray, who opened the discussion, said that it came as a surprise to find that the nuclear crystals apparently were not recognised at all in the official reports, because, as far as one could judge from the reproductions of the ingots, especially of cross-sections, the whole of the middle of the castings was of the nuclear type and the difference between the nuclear crystals and the dendritic type round them was very unusually clearly marked.

The President (Dr. H. H. Burton) asked whether the members of the Committee considered that their samples were really large enough to enable many conclusions to be drawn, and whether the ranges of temperature were anything like sufficiently wide to enable any sort of answer to be given.

Mr. H. Allsop said, with regard to the President's point, that they had examined actual ingots of

approximately the same dimensions, and also a number of ingots of similar type nickel-chromium steel of rough... the same size made under conditions of wide variations in testing temperature and testing speed. The differences in respect of the general primary dendritic crystal form were no greater than those shown. He believed that within the size range of up to 13 cwt. the samples could be taken as representative and adequate.

Mr. Gray had said that the Committee had made no reference to the nuclear crystals. That was true, because the nuclear-type of crystals were present in all four ingots. The general distribution of them was not significantly different.

Mr. K. C. Barraclough, in a brief final reply, said that with regard to the size of the sample, obviously there was a limit to what could be done in the way of the cutting up of ingots. The main thought behind the experimental work described was the possibility of obtaining a reasonably wide range of temperature and casting speed from one particular casting. That there were no larger differences than had been found was a surprise to all the Committee.

One of the reasons why this particular type of steel had been chosen was that it was one in which trouble had been experienced in the ingots with regard to transverse cracking.

To be continued

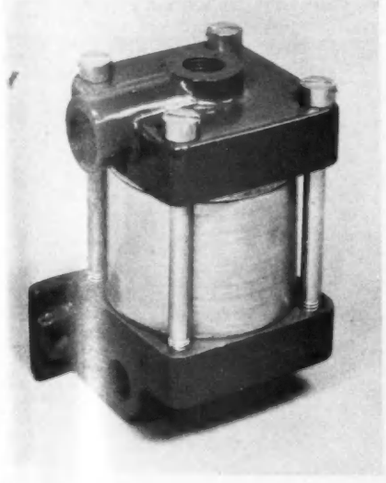
* * *

ELECTROMAGNETIC PILOT VALVE

For use with either compressed air or hydraulic oil, two pilot valves have been developed by the Baldwin Instrument Company, Limited, Brooklands Works, Dartford, Kent. Both utilise the same electro-magnetic actuator, but one has an unbalanced and the other a balanced mechanism. The external appearance is shown in the illustration.

The valves are of the glandless poppet type, and have a maximum consumption of 4 watts using direct current. For supply voltages of 130 or higher, a dropping resistor is required, which is supplied as a separate unit. When continuously energised, the average temperature rise is 35 deg. C., and as the speed of response is high, as many as 600 operations per minute being possible.

The unbalanced version has a full bore capacity of $\frac{3}{16}$ in. and can handle air or oil up to 150 lb. per square inch. The balanced version has a bore of $\frac{1}{8}$ in. and can handle pressures up to 100 lb. per square inch. Either may also be used for vacuum service. Both versions are of the three-way type and may be used to control small single-acting power cylinders directly, or as pilots for the control valves of large cylinders. Body and top cover are of bronze, ferrous components are electro-plated, and the valve seat is made of soft synthetic rubber which is both oil and water resistant.



As many as 500 operations a minute can be obtained with this pilot valve for air or oil circuits.

RESEARCH ON SURFACE COATINGS, DETERGENTS AND PLASTICS

A LABORATORY TO HELP USERS

With the rapid development, since the second World War, of chemicals produced from petroleum, new problems are arising in the techniques of their uses. To assist customers in solving these problems, the Shell Chemical Company, Limited, Norman House, 105-109 Strand, London, W.C.2, have recently inaugurated their Egham Technical Services Laboratories.

The new laboratories comprise the following departments: a surface-coatings workshop for the manufacture of various types of surface coating, and a surface-coatings laboratory where tests are carried out for customers on problems connected with surface-coatings, paints, varnishes and lacquers. The tests include those for drying time, impact resistance, flexibility, viscosity, colour, abrasion resistance, hardness and brushability.

A resins laboratory and constant-temperature room are equipped primarily for work on Epikote resins in the plastics field. Resins of this type are used for casting and "encapsulating" electrical equipment, and as laminates. The test apparatus includes dielectric test sets and resistance meters, tensiometers, flexural strength machines, impact strength machines and other mechanical test machines, some at elevated temperatures.

A market development workshop houses heavier plant for the evaluation of resins and plastics; hydraulic presses to prepare test pieces and laminates; a mixing mill for processing rubber and thermo-plastic compositions in sheet, tube and rod form; and a varnish plant with filter presses and other equipment for preparing synthetic resins or their derivatives applicable both in the plastics and surface-coatings fields.

In the detergents laboratory practical problems in the use of detergents are studied in addition to the physical properties such as surface tension, etc. Chemicals which fall outside the categories of resins, surface-coatings or plastics are studied in a general chemical laboratory, and chemical analyses for all the specialised laboratories are carried in an analytical laboratory.

Although the main function of the Egham laboratories is service for the customer, there is, in addition, a small fundamental research laboratory under the direction of Sir Robert Robinson, O.M., F.R.S., the work of which is closely integrated with research carried out by the Royal Dutch Shell Group.

In addition to the technical service activities, training courses are to be held at the laboratories, both for the company's own staff and for customers. It is intended that the laboratory staff shall spend no more than about three years in the laboratory, after which they will be sent out to renew their contact with industries.

DESIGN OF A LABORATORY

Because of the expanding nature of the petroleum chemicals industry, the new Technical Services Laboratories of the Shell Petroleum Company at Egham have been designed so that the layout can be altered as required in the future.

General view of the new Shell Chemicals laboratories for customer service; built out over the lake is the conference room, serving structurally as one of the main stiffening units.

A laboratory bench of standard size has been selected as the design module of the building, the length and width of each laboratory being exact multiples of this unit. The normal laboratory services of gas, water, compressed air, vacuum and drainage, as well as lines for the future provision of steam and nitrogen, have been arranged so that any bench can be turned through 90 deg. or 180 deg., removed altogether, or repositioned within a multiple of its length without interrupting other services. All the lateral partitioning in the building can be removed and re-erected at any point along the module line without affecting bench spacing or interfering with service outlets.

The laboratory building consists of a framed structure with reinforced concrete columns carrying steel lattice beams designed to permit the free passage of ducts and services from the overceiling space. The necessary stiffness is provided by the main entrance unit and the conference room, which are reinforced concrete box frames. To reduce the overall weight the suspended floors are hollow tile units.

The constant temperature and humidity room is insulated with cork slabs sprayed internally with a plastics cocoon as a barrier, this vapour seal forming an internal decoration. The windows are double glazed, solar gain being provided by using non-actinic glass externally with built-in venetian blinds set between the two panes of glass.

An air-conditioning plant is in an adjoining sound-proof room, the equipment being sup-

The laboratory benches, of standard size, are movable and interhangeable, and have been used as the design module for each laboratory. The main laboratory services are arranged to give the maximum flexibility in layout. Shown here is the surface-coatings laboratory.

ported on a floating floor discontinuous with the rest of the structure so as to minimise the transmission of vibration. The two workshops are similarly isolated.

The whole of the first floor of a market development workshop is removable, to facilitate the subsequent erection of lofty equipment if required.

Throughout the laboratory offices the Frenger system of ceiling panel heating has been adopted. Convectors are used below the floor in the conference room, and in the two workshops they are built into the walls. Low-pressure hot water is pumped through pipe coils forming the ceiling grid, to which are attached perforated aluminium panels. Zonal controls have been provided according to aspect, with automatic mixing valves controlling the water temperature in each zone.

Fume extraction points have been provided at approximately 10 ft. centres in each laboratory; each fume cupboard or hooded bench is a self-supporting unit and, like the standard bench, can be repositioned as required. To counteract the sudden temperature drop consequent upon the air extraction through fume cupboards, a make-up air system has been provided so that filtered warm air is drawn into the laboratories to replace the air extracted. Cellular ducting is used for all fume extraction, each hood or cupboard being separately ducted to obviate the possibility of danger accruing through the mixing of incompatible gases. The ducts are collected in a vertical stack and discharged through centrifugal fans on the roof.

All main services are located in an external peripheral ring duct from which branches are taken into the building at modular points to serve the benches. Each branch service is separately controlled and can be isolated without disturbing the mains; a busbar system has been used for electrical services. Laboratory drainage is in chemical stoneware, the effluents being collected and treated in settling tanks before being pumped into the main drainage system.

The consulting engineer for the laboratories was Mr. Maurice Hachshen, B.Sc., M.I.C.E.; the general contractors were Trollope and Colls, Limited; and the architects were Walker Harwood and Cranswick.

A RECORD IN ELECTRICAL GENERATION

An outstanding achievement in electrical generation at high plant load factor and low fuel cost occurred at Skelton Grange power station in the Yorkshire Division of the Central Electricity Authority at the end of last year. At that time the station was equipped with five 60 MW Parsons turbines of the three cylinder reaction type, which were supplied with steam at 900 lb. per sq. in. and 925 deg. F. and were coupled to hydrogen-cooled alternators. During the week ending December 9, 1955, these five machines generated 50,436,200 kWh, which was equivalent to a plant load factor of 100 per cent. Although this figure has been reached before on smaller sets it is doubtful whether it has previously been associated with an output of more than 50 million kWh. Even this achievement, however, was surpassed later for a sixth 60 MW machine had been placed in commission on December 14 and 58,078,300 kWh were generated with its assistance in the week ending January 6, 1956. This may well be the greatest output ever produced during one week in a single power station in this country. The end, however, was not yet, since during the week ending January 20, 59,346,700 kWh were generated; and in that ending January 27 no less than 59,629,400 kWh. Of the latter amount 56,478,600 kWh were sent out, which is equivalent to a load factor of 100·05 per cent. on that basis. For comparison it may be recorded that the amount sent out was equivalent to 3·34 per cent. of the total from all stations in the country; and that the average weekly electricity consumption during January in the Leeds district, to which Skelton Grange is adjacent, was about 14½ million kWh.

While producing this record output Skelton Grange also retained its position as the station with the lowest fuel cost per unit sent out in the country. In fact, to generate 59,629,400 kWh 28,983 tons of coal were consumed, including 5,746 tons of fines, dusts and slurry and 2,808 tons of open-cast. The average calorific value was 10,132 B.Th.U. per lb. and the overall thermal efficiency of the station was 29·28 per cent. Such results are a tribute to the skill of those who designed the plant and station (which was fully described on page 510 of our issue of April 22, 1955) no less to those who were responsible for its operation.

NEW PERMANENT MAGNET MATERIALS

Members of the Permanent Magnet Association, 301 Glossop-road, Sheffield 10, have introduced three new materials, which should be of particular interest to loudspeaker manufacturers. These materials, which are to be known as Alcomax II S.C., III S.C. and IV S.D., are semi-columnar in structure and are modifications of P.M.A. Columax. The latter, however, although it has the highest performance of any permanent magnet material, is not suitable for economic bulk production. On the other hand, the new materials being semi-columnar are more easily adaptable to existing methods of large-scale manufacture. In performance they are intermediate between Alcomax and Columax, although it has not been possible so far to specify their properties completely. A general comparison between Alcomax III and Alcomax III S.C. is, however, given in the curves reproduced in Fig. 1.

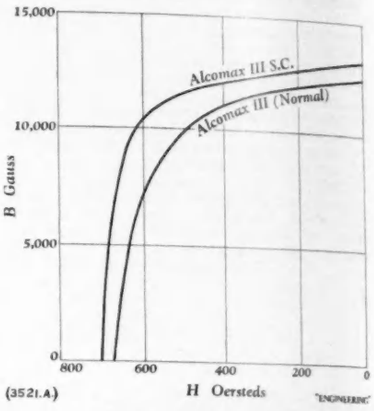
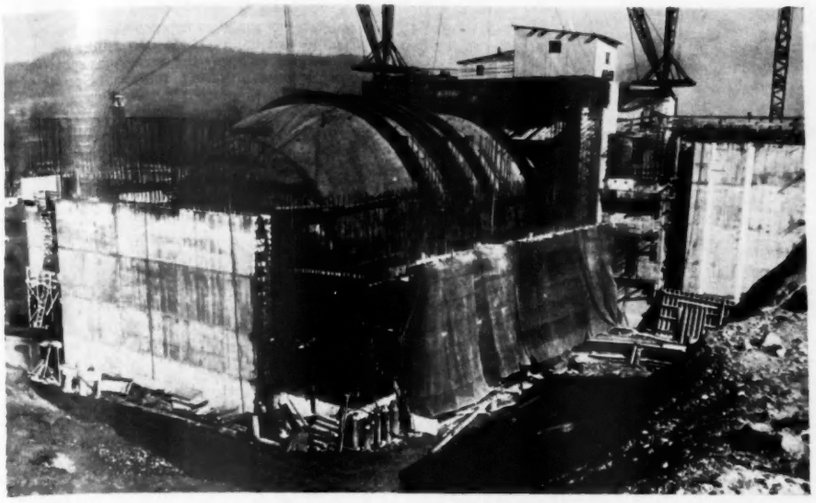


Fig. 1 General comparison of the magnetic properties of the new material Alcomax III S.C. with the normal Alcomax III.

The development of the crystal structure necessary to give an improved performance is limited to certain shapes and sizes; plain solid cylinders having a diameter of over ¾ in. and a length somewhat less than the diameter being the most suitable. In the early stages, manufacture will therefore be limited to such magnets. The difference between the crystal structure of Alcomax and Alcomax S.C. can be appreciated by comparing the micro-photographs reproduced in Figs. 2 and 3, the magnification being ×4 in each case.

Fig. 2 Crystal structure of Alcomax III. Magnification ×4.

Fig. 3 Crystal structure of Alcomax III S.C. Magnification ×4



[Picture by courtesy of Westinghouse Electric Corporation]

Building a reactor involves all branches of engineering, not only electrical and mechanical, but civil too. The pressurised-water reactor at Shippingport, U.S.A. is now well on its way to completion.

Book Reviews

A GUIDE TO REACTOR ENGINEERING

Principles of Nuclear Reactor Engineering. By SAMUEL GLASSTONE. *Macmillan and Company, Limited, St. Martin's-street, London, W.C.2.* (60*s.*)

The two previous works on nuclear energy edited by Dr. Glasstone, *Sourcebook on Atomic Energy* and *The Elements of Nuclear Reactor Theory*, have become authoritative sources of information for the atomic energy worker, and this new book on reactor engineering will probably assume a position of equal importance among those people whose work and interests demand a more general and overall picture of the nuclear reactor field, but not a very specialised knowledge of any particular branch. It is no doubt a formidable task to provide in a single volume all the information required by the reactor engineer. He must at times be expert in the fields of mechanical, civil or electronic engineering and he must be in a position to appreciate and put to use the discoveries of his colleagues in the fields of physics, chemistry and metallurgy. In Dr. Glasstone's latest book all these aspects are covered to a greater or lesser degree, and an engineer wanting a general picture will find adequate coverage to help him appreciate the appropriate place of any particular topic and its relative importance in determining the present position and the rate of development of nuclear power. Particular subjects are rarely covered in sufficient detail to give the reactor design engineer all the information he will require in his final considerations, and such workers will no doubt have to refer to special texts and papers on the particular aspect under consideration, but this should not be taken as a serious criticism of the book as it is clear that such is not its purpose.

The book is divided into thirteen chapters and opens with a summary of the nuclear physics required for an understanding of the basic fundamentals of reactor operation. Only those aspects of nuclear reactions are discussed which are required for an explanation of fission and of the various radioactive processes arising in reactors, but this will most likely be adequate for the readers in view. The following chapter on reactor theory deals with such topics as neutron diffusion, slowing down, and the concepts of buckling and critical size. Much of this material has been taken from the previous work, *The Elements of Nuclear Reactor Theory*, and the approach set out has become established as the standard method used in reactor nuclear calculations. More advanced topics, such as transport theory and perturbation theory are not included, and since reactor types now being considered probably require such techniques of analysis it may be levelled as a criticism that something on these methods should have been introduced.

The theory of reactor time behaviour is dealt with at some length, but it is unfortunate that the all important effect of temperature on reactor dynamic stability is somewhat sketchily treated. This criticism must be directed even more strongly at the chapter on reactor control, where the omission is a serious matter. The treatment of those reactor transients not seriously affected by temperature is quite adequate, for example during reactor start up.

The two sections following might be labelled reactor chemistry, since they deal with the two major topics, material production for reactors and the chemical treatment of spent fuel elements. Under the heading of materials we find an excellent account of how uranium metal is produced from the ore and a brief, but extremely clear explanation of the operation of diffusion plants for producing enriched fuel. The inclusion of how some other important materials in reactor operation such as thorium, heavy water, beryllium and some sheathing materials are made available is to be welcomed, since the cost of such processes has ultimately a direct effect on the economics of nuclear power. The engineering difficulties associated with the use of materials under intense neutron irradiation are major problems in reactor design and it is well that the mechanisms of irradiation effects on metals and fluids are covered in the text; particular aspects such as fuel element damage and dissociation of water under neutron bombardment are covered at some length. The section devoted to fuel-element processing describes mainly ion exchange and solvent extraction methods, and the problems of waste disposal. One of the advantages of some future types of reactors is often stated to be the possibility of continuous processing of the fuel, and it is clear that the cost of these methods is going to be important in economic considerations; for that reason it is certain that the ideas set out in this section on processing techniques are important now and may be more so in the future.

One of the major considerations in reactor design is undoubtedly that of heat removal from the core, and unquestionably this factor is as important in determining reactor geometry as are considerations of the nuclear requirements. For that reason it might have been expected that more space in the text might have been devoted to this subject. The reason why liquid-metal heat transfer is so desirable is covered in a few lines, and few of the heat-transfer correlations covering different boiling regimes are given. Also, an analysis of pressure drop in reactor channels with heat addition should have been included. One might also expect to find in a book on reactor engineering some discussion of the effect of different types of coolant on the final steam cycle and conditions chosen, for example the important difference of specific heat between gases and water, which may lead to the use of a dual-pressure cycle on the one hand and external superheating on the other. The omission of these considerations from the section on heat removal does not condemn it however, and in fact much interesting and useful material is contained therein.

In the final chapter of the book some existing reactors are described rather briefly and while these will probably be interesting to the new reader it is perhaps desirable that some extension of this part should take place to make it generally useful.

Considering the book as a whole, there is no doubt that a major task has been completed very well, and it can be predicted that in a very short time a copy will find its way into the bookshelves of all working in the atomic energy field and also of many more who have contact in any way with this new form of power production. New entrants to nuclear energy work and practising engineers requiring an overall view of the subject will find the book most valuable in that it presents very well the fundamental scientific principles underlying this comparatively new subject.

GREEN FINGERS WANTED

Plant Maintenance in Practice. British Productivity Council Case Studies No. 2. *British Productivity Council, 21 Tothill-street, London, S.W.1.* (2*s.* 6*d.*)

The preoccupation of industry with designing, constructing and operating plant has tended to obscure the task of keeping it in good running order. The cost and complication of modern machinery are beginning to force a change of attitude, leading to some of the more advanced firms employing maintenance engineers who are of a calibre equal to that of designers and production managers, and insisting on maintenance being planned on the lines of a production programme.

In devoting their second pamphlet of case studies to plant maintenance, the British Productivity Council show a welcome awareness of the importance of the subject. It is significant that all the 13 systems studied are in large and progressive firms. The introduction laments the failure to find a really small firm attempting rational maintenance control. Although not seeking an explanation (it probably lies in faulty accounting, i.e., not setting appropriate production deficiencies against bad maintenance), all the studies emphasise the benefits of higher availability, longer life and improved product—factors which are equally important to firms of all sizes.

Aware of the limitations as well as the possibilities of the case study method, the B.P.C. makes no attempt to describe how to introduce rational maintenance. The reader is given a number of graphic summaries of what has been done and the benefits achieved, but except for a broad hint that industrial consultants are good at planning maintenance and applying incentives, the industrialist with an appetite for economy is given little guidance on how to do it. He has in fact the choice of three methods: (1) engage an engineer experienced in planned maintenance; (2) call in consultants; (3) engage a capable man to start from scratch. Whatever is done, the

planner must be free from day-to-day distractions of maintenance responsibility.

The booklet stresses the diversity of maintenance schemes, and although a wide range of industries is covered, it is strange that civil aviation has been left out. Of all the branches of engineering, none demands such attention (economic and technical) to maintenance control as aeronautics. Perhaps the omission can be traced to the fundamental error of the pamphlet which is that it sees no hope of finding common ground on which to base a philosophy of maintenance. The similarities of the problems and of the solutions appear to have been disguised by the different words used to express them, as well as a tendency to fog the issue with work study and incentive payment. These latter are of immense value, but are not a necessary part of planned maintenance.

There are four fundamental steps in planning maintenance for a piece of equipment. They hold equally for an aeroplane, a steam boiler or a railway track, and are: (1) state what maintenance is necessary, who is to do it and at what intervals; (2) organise a system to pass written instructions at the correct time to the people determined in (1); (3) keep records of scheduled and unscheduled attention given, and reports on the condition of the equipment; (4) peruse records and modify (1) accordingly. Then come work study, incentives and all the trappings.

The four essentials can be verified by a careful reading of the case studies, particularly the system of Kodak, Limited. This organisation has on one site types of plant perhaps as diverse as the other 12 put together, yet one unified system covers the lot.

The pamphlet shows, but does not clearly say, that there are two criteria on which servicing should be based: the consequences of failure and the rate of deterioration. All the schemes reported are quite young (for more venerable planned maintenance, consult the armed forces, British Railways and the nationalised air transport corporations) and there is every reason to believe that, in ordinary industry, there is great scope for inquiry into the best ways to effect the four fundamental steps and for a detailed study of the fundamental criteria. Perhaps a few firms with six-figure maintenance budgets will take the hints from the pamphlet and chance a little money on maintenance research. It would be pleasant to lay hold on just a fraction of the possible savings.

★ ★ ★

NEW BOOKS

Some of the books noticed here are selected for extended review in ENGINEERING.

Marine Auxiliary Machinery. Edited by E. MOLLOY. Second edition. *George Newnes, Limited, Tower House, Southampton-street, London, W.C.*2. (35*s.*)

Maintenance engineers are normally responsible for a wide diversity of equipment and have difficulty in finding any one book that covers all the machinery they are likely to meet in the course of their duties. This book, which is uniform with the Newnes Marine Engineering Series and treats comprehensively the different kinds of auxiliary machinery employed in ships, meets this requirement. Various contributors combine to provide an overall picture of the intimately connected systems which serve the main propelling machinery, supply domestic requirements, and ensure the safety of the ship. The first six chapters are concerned with the feed, bilge, ballast, freshwater, circulating, lubricating and other fundamental systems, and with the piping, valves and plant associated with them. The second part of the book is devoted to particular specialised auxiliaries such as steering gear, propellers, refrigeration, ventilation and heating systems, deck machinery and safety equipment. Among the items described are numerous pumps including the Weir multi-stage turbo-feed pump, and the Hastie variable-delivery rotary-plunger pump which is used in conjunction with that company's steering gear (see page 461). In this second edition a section has been added dealing with the Denny-Brown stabiliser.

Building Mastics; and Bonding New Concrete to Old. Building Research Station Digest No. 82. *H.M. Stationery Office, Kingsway, London, W.C.*2. (3*d.*)

This Building Research Station Digest is concerned with two independent subjects: (1) Building Mastics and (2) Bonding of New Concrete to Old. In this digest "mastics" is taken to mean those materials used in building work for sealing, joining or bedding. Some merely seal a gap and may harden to any degree as long as they do not shrink unduly; others, by remaining soft, can also pick up movements. Mastics include such materials as bitumen, tar, resin, rubber and oils, and may contain other inert fillers. The digest sets out the properties of each material and the recommendations for its particular use. The second part of the digest reviews previously published notes on bonding new concrete to old, as has been previously described in digests that are now out of print.

Tables of Weber Parabolic Cylinder Functions. Computed by Scientific Computing Service, Limited. *H.M. Stationery Office, Kingsway, London, W.C.*2. (63*s.*)

This volume, edited by Dr. J. C. P. Miller, contains new tables of the functions introduced by H. Weber for the solution of the wire equation in two dimensions in parabolic co-ordinates. The contract for the computation of these tables was placed with Scientific Computing Service, Limited, by the National Physical Laboratory which sponsored the project, and the work was supervised by Dr. Miller, who also wrote the mathematical introduction which is of a very comprehensive character and entailed much work in the derivation of new formulae. The tabular material, which is based on Whittaker's form of the differential equation, gives two independent solutions together with various auxiliary functions, including gamma functions, to about eight significant figures. The functions tabulated arise in a wide variety of problems in physics, engineering and mathematics and the book will be of great value to research workers in these subjects.

Prestressed Concrete. By Y. GUYON. Edited by W. M. JOHNS. Second impression. *Contractors Record, Limited, Lennox House, Norfolk-street, London, W.C.*2. (70*s.*)

This is a second impression of a free translation of M. Guyon's book *Béton Précontraint*, originally published in 1951. The opportunity has been taken to bring the work up to date and also to correct small errors that have been noted in the original edition. The book is a comprehensive work of reference and also a text-book for students. Reference is made to the properties and characteristics of the constituent materials, as well as to the behaviour of prestressed concrete members. A brief history is given of the development of the techniques of prestressing, together with descriptions of current practice and expedients. Fundamental formulae are derived for beams of different sections, and design problems are considered for statically determined straight beams. A review is given of experimental investigations that have been made on such members and one chapter is devoted to a consideration of factors of safety and elasto-plastic design. The numerous examples given in the text are evaluated in English units.

Machine Design. By PAUL H. BLACK. Second edition. *McGraw-Hill Book Company, Incorporated,* 330 *West* 42*nd-street, New York* 36, *N.Y., U.S.A.* (7.50 dols.); and *McGraw-Hill Publishing Company, Limited,* 95 *Farringdon-street, London, E.C.*4. (56*s.* 6*d.*)

Emphasis on practical design rather than academic analysis is the keynote of this book by the Professor of Mechanical Engineering, Ohio University. It is intended as a text-book for courses in general machine design and as a reference book for design offices, and its chapters are generally divided in terms of machine details such as springs, clutches and brakes, rolling contact bearings and motors. Among the subjects treated are welding and fabrication, wire-rope construction and gear-tooth failure; while particular items described include the Morse silent chain and the ball-bearing screw and nut. The book, which is well illustrated by mechanical drawings, diagrams and half-tone prints, has appendices on theoretical principles, standards and constants, a section containing questions and problems, and both author and subject indexes.

Vector Analysis. By HOMER E. NEWELL, JR. *McGraw-Hill Book Company, Incorporated,* 330 *West* 42*nd-street, New York* 36, *N.Y., U.S.A.* (5.50 dols.); and *McGraw-Hill Publishing Company, Limited,* 95 *Farringdon-street, London, E.C.*4. (41*s.* 6*d.*)

Though compiled primarily as a college text-book of roughly degree standard, the author also intended it to be of use as a reference work for vector techniques. Part I is devoted to a full treatment of vector algebra and vector calculus, while Part II provides the illustrations in terms of applications to kinematics, mechanics and electromagnetic theory. No reference is made to problems in hydrodynamics or elasticity but the author observes that the student should be able to apply the techniques quite well to these and other omitted subjects. Special effort has been made to present the development for the benefit of the physicist and engineer rather than for the mathematician, and to this end much of the material is contained in worked examples.

★ ★ ★

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given though distribution is sometimes restricted.

"Know Your Tractor." SHELL PETROLEUM CO. LTD., St. Helens-court, London, E.C.3. The latest of the Shell guides, "Know Your Tractor," is intended to supplement the information issued in the instruction manuals of manufacturers. It covers most makes of tractor of the types used in agriculture and general service, including both wheel and track machines. The 350 pages have 124 illustrations and diagrams (some in colour) and are divided into 16 main chapters. Typical headings are: The Tractor Engine; Fuels and Fuel System; Electrical Equipment; Lubrication; and Power Applications. The book is available free to colleges, institutions and farmers.

High-Temperature Heat Transfer. HYGROTHERM ENGINEERING LTD., 37 Upper Brook-street, London, W.1. Organo-silicate heat-transfer liquids (tetra aryl silicate) with boiling points up to and exceeding 850 deg. F. and pour points down to −100 deg. F. and below; good thermal conductivity and heat stability, non-explosive, no toxic fumes, non-corrosive, low fire hazard. Characteristics and physical properties. Also heating systems and equipment employing Hygrotherm liquids. Illustrated leaflets and technical reprints.

Sectional Belt Conveyors. LINK BELT CO., 307 North Michigan-avenue, Chicago 1, Ill., U.S.A. "Pre-Bilt" sectional belt conveyors in standard units with capacities up to 1,500 tons per hour. Widths of 18, 24, 30 and 36 in. available. Range of components and items enables any length of horizontal or inclined conveyor to be built from stock parts. Complete sets easily moved from site to site. Illustrated booklet No. 2579.

Central Heating Boilers. TRIANCO LTD. (Heating Division), Imber Court, East Molesey, Surrey. Automatic boilers for central heating with models ranging from bungalow to public building size. Regulation by thermostatically controlled fan. Combustion gases are given a whirling motion through the tubes. Suitable for firing by most solid fuels. Leaflet.

Fluorescent Inspection Lamp. SIR THOMAS EDELSTON & PARTNERS LTD., 28/30 Sussex-place, London, W.2. The "Step" hand lamp for inspection work. Fluorescent tube has 2,000 hour life and is roughly equivalent to 60W bulb. Rubber hand grip and cap. Perspex cover. Overall length 12 in. diameter 1¼ in., weight 9 oz. Consumption 6W from mains supply. Illustrated leaflet.

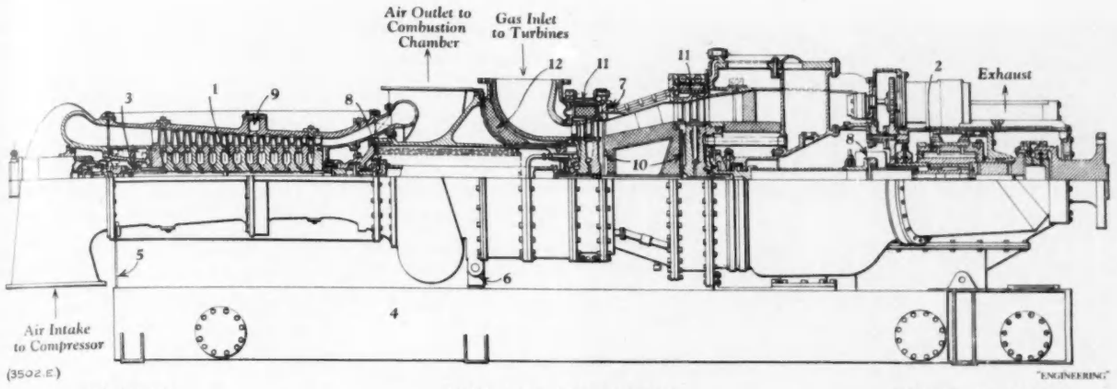
Signalling. WESTINGHOUSE BRAKE & SIGNAL CO. LTD., 82 York-way, King's Cross, London, N.1. Items for railway signalling. New sections to be added to the general catalogue, covering apparatus cases; time element (thermal and vane) relays; point machines for trailing operation; circuit controllers; and block instruments. Illustrated description leaflets.

Blowers and Exhausters. W. C. HOLMES & CO. LTD., Turnbridge, Huddersfield. Re-designed versions of Holmes-Connersville blowers, boosters and exhausters. Improved glands and heavier shafts to avoid torsional vibrations. Overall length reduced. Preliminary leaflet No. 61.

Roller-Bearing Axle Boxes. HOFFMANN MANUFACTURING CO. LTD., Chelmsford, Essex. Records of the application of roller-bearing axleboxes to locomotives, railcars and rolling stock. Illustrated booklet gives details of various types and sizes, and illustrates their application.

Transistor Power Supplies. MULLARD LTD., Century House, Shaftesbury-avenue, London, W.C.2. The use of transistors in circuits for obtaining high tensions and extra high tensions from low voltage sources. Illustrated reprint.

Electric Clocks. GENERAL SIGNAL AND TIME SYSTEMS, LTD., 73 Great Peter-street, London, S.W.1. Time recorders; slave clocks; programme instruments; staff location, paging and master-clock controlled systems. Illustrated leaflet.



SIMPLICITY

(1) Only two moving elements—gas generator rotor and power turbine.
(2) Built-in epicyclic reduction gear.
(3) Sleeve-type bearings.
(4) Combined fabricated underbed and lubricating oil sump.

KINEMATIC CONSTRUCTION

(5) Flexible support for compressor to allow for casing expansion.
(6) Trunnion mounting for compressor turbine support.
(7) Flexible intermediate duct between turbines.
(8) Flexible couplings in rotor shafts.

EFFICIENT AIR COOLING

(9) Self-contained system fed by compressor.
(10) Disc cooling.
(11) Built-in stator cooling.
(12) Double skin construction and internal lagging.

Fig. 1 The Ruston and Hornsby TA gas turbine (750 to 1,000 kW) has been designed on simple and robust " vertebrate " lines to serve a wide variety of purposes and yet permit series production methods. Features contributing to ease of manufacture and adaptability are listed above.

A GAS TURBINE IN SERIES PRODUCTION

BATCH TEST FACILITIES FOR A VERSATILE ENGINE

Two somewhat conflicting factors had to be reconciled when Ruston and Hornsby, Limited, of Lincoln, planned production of their TA industrial gas turbine. First, a considerable demand for the engine was anticipated, so that series production could conveniently be adopted —output is now in the region of one a fortnight— and second, its applications, and particularly the fuels it would be called upon to burn, were likely to vary widely. These variations had thus to be reconciled with series production methods, and a batch system of testing devised.

OMNIVOROUS VERTEBRATE

Fortunately, the unit itself was very adaptable —having without major modification an " omnivorous " appetite for different fuels; a simple and robust " vertebrate " construction (see Fig. 1), and flexibility in the arrangement of ducting and external connections. Only one formidable problem remained to hamper series production: that of series testing. To overcome this difficulty a special test house has been built together with a propane plant, which can supply gaseous fuels with a wide range of calorific values. Details of the Ruston TA 750 to 1,000 kW turbine, for which the new installation has been primarily designed, have previously been published in ENGINEERING (vol. 175, page 321, 1953; vol. 181, pages 140 and 360, 1956).

To indicate the range of operating conditions that had to be catered for in designing a suitable test house, some account of the engine's versatility may be given. This can best be done by reference to certain of the fuels on which it has run and by listing some of the circumstances in which machines are at present or will soon be operating.

The engine, which can develop an output of 1,300 h.p. when running non-recuperatively and can give efficiencies of over 70 per cent. when heat recovery—with or without afterburning—is employed, has proved specially valuable for installations requiring both power and process heat, though not all the plants named have been designed for this purpose. Units have been built for oil companies (Ecuador, Kuwait and elsewhere), diamond mines (Tanganyika), cement works (Venezuela), a water distillation plant (Australia), sewage installations (eight turbines for the London County Council), and for various United Kingdom companies, the Bank of England printing works at Debden (this unit has heat exchangers and exhaust heat recovery), the Air Ministry and the Admiralty. Most of the running experience so far obtained has been with two machines installed in Italy, both of which operate on natural gas. One, made for A.G.I.P. and installed at Cortemaggiore has run for some 6,000 hours and the other at Donato (S.N.A.M.) has so far completed 3,000 hours. Other applications for which the engine is suitable include railway traction and use as a portable power plant.

RANGE OF FUELS

Many different fuels are used in these installations and particular attention has been given at Lincoln to fuel trials. Such possible fuels as natural gas, sewage gas, blast-furnace gas, producer gas, and also gas oil, residual oils, creosote pitch (C.T.F. 200), carburetted water gas tar and pulverised peat have been tested. Although the propane plant can naturally only supply fuels corresponding to certain of those named, tests for other fuels are also carried out at the Ruston works. Well over a 1,000 hours turbine testing has, for example, been carried out on C.T.F. 200. For this fuel a refractory-lined combustion chamber has been developed because of two main combustion problems: first, the high radiation from tar-fuels with the resultant problem of cooling metal-walled combustion chambers, and, second, the tendency to form " golden rain " in the exhaust; this is associated with the high carbon-to-hydrogen ratio of tar fuels. The use of refractory walls enables the high flame radiation to be used to assist in burning out the " golden rain " (incandescent carbon particles) and is ideal from the combustion point of view. It does, however, present difficulties from the turbine aspect.

A very wide range of refractory materials have been engine tested over extended periods and the present material has completed over 400 hours with complete satisfaction. With refractory linings, warming up and shut down of the turbine have to be taken more gradually but this presents no difficulty for the base-load applications for which tar fuel burning turbines are normally considered. An air-blast assisted pressure-jet sprayer is used so that the best possible atomisation of the fuel can be obtained, leaving some margin in hand for any worsening of conditions that may occur in service. The air is drawn from the gas turbine compressor through a pre-cooler to a single-cylinder piston compressor arranged to give a compression ratio of 2-to-1. A number of different tar fuels in the C.T.F. 200 grade have now been tested, and as a result of this experience, it has been possible to decide on the type of fuel which the gas turbine can burn without difficulty. As a result, a restriction is placed chiefly upon the soda content of the tar which can be met without undue difficulty by fuel suppliers.

However, most of the machines now in

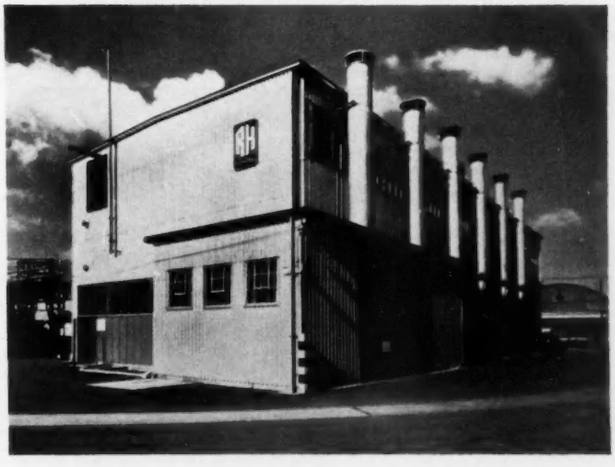


Fig. 2 In the construction of the new Ruston test house, wide use has been made of aluminium decking on a steel framework. Acoustic tiles provide combined thermal and sound insulation.

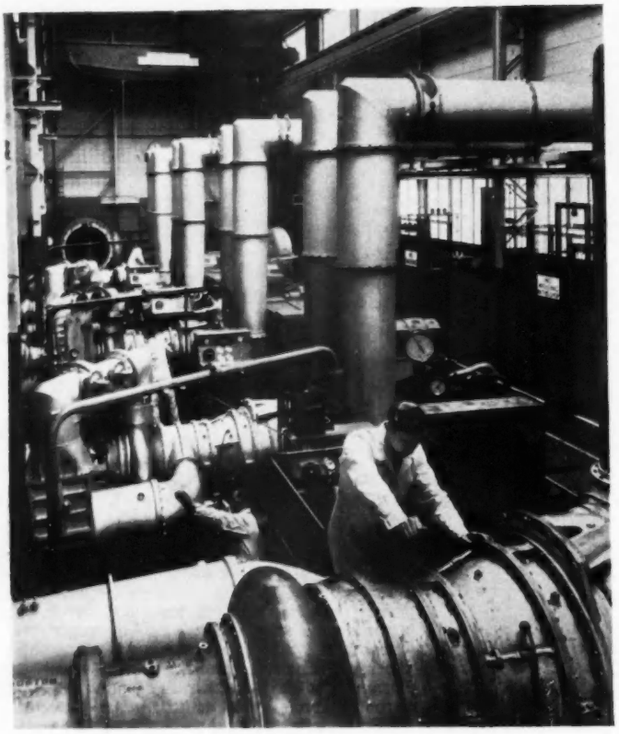


Fig. 3 Interior of turbine test house. It has been largely designed to accommodate the TA turbine, six of which can be tested simultaneously. Series production is thus followed by batch testing.

production are for use with gaseous fuels and may therefore be conveniently tested in the new test house, which is shown in Fig. 2 and supplied with fuel from the propane plant. Though of moderate size, the building is one of the few gas-turbine test shops in the world in which six turbines can be tested simultaneously on various types of fuel. It may be expanded when the need arises.

TEST BUILDING

The building is of steel-framed construction, 132 ft. long by 52 ft. wide by 38 ft. 9 in. to the under-side of the roof members. A grid consisting of eight 16 ft. 6 in. sections was chosen to allow sufficient space for one complete turbine test bed per bay. The width of 52 ft. includes an 11 ft. annexe, which provides the main shop gangway and supports the air inlet filter gallery at ceiling level. This gallery runs the full length of the building on the south side and air is drawn in through fixed aluminium louvres. At the west end, two intermediate floors in the annexe are used for offices, fine fitting work and other purposes. At the east end, a fixed high-level gallery provides a further bed for testing those turbines which will operate with heat exchangers. The flat roof is covered by Briggs aluminium decking and the building generally is clad externally with corrugated aluminium sheet, supplied by the Northern Aluminium Company. Rust coloured asbestos corrugated sheet has been used on the permanent north and east elevations, which also have a high proportion of glazing. This natural lighting is also assisted by a 12 ft. roof lantern running throughout the length of the shop.

A large area of the shop is lined by Burgess acoustic tiles providing combined thermal and acoustic insulation. These tiles are perforated metal trays containing glass fibre. In addition to having a high fire resistance, they were chosen as being reasonably easy to dismantle and re-erect on the two sides on which extension is expected. While the noise of turbines running is not noticeably contained, reverberation within the shop is lessened and good working conditions are achieved. The lighting throughout the shop is fluorescent, fixed in most cases to continuous trunking. Each crane-track carries one row of fittings and there is a central row in the roof. Heating is by high-pressure hot water radiant panels. The heat from the turbines under test can be fully utilised, since the panels are automatically regulated by atmospheric temperature.

TEST BEDS

The shop, the interior of which can be seen in Fig. 3, has been largely designed around the standard TA turbine, although provision has been made for two beds on which very much larger units can be tested, if required. Six beds are provided, one vehicle-entry bay and one bay for unloading, packing and dispatch. Two beds at the east end are available for heat exchanger sets and have been arranged so that most site conditions can be reproduced on test. One of these beds is on the permanent gallery 17 ft. above floor level, and the other employs movable cast-iron blocks and girders which can give increments in height up to 10 ft. from floor level. All services are placed below ground level. Service trenches carry oil fuel lines, compressed air, welding, power and test cables, liquid propane gas fuel, river and towns water. Branches carry the services from the main ducts to the separate beds. A 25 ton overhead crane, geared to 8 tons, copes with all turbine and driven machinery loads and most heat exchangers. Three 10 cwt. jib cranes mounted on crane stanchions have been sited to cover the entire length of the turbine for light fitting and erection work.

Inlet air for the turbine is taken from the outside atmosphere into the filter gallery. Each turbine bed has its own separate filter unit, which can be moved into position to suit the air inlet connections of the compressor. The frame on which the filter sits supports the venturi, silencer and standard connecting ducting which hang vertically and are also designed to meet most standard arrangements of compressor inlet. The twin exhaust ducts are taken to the north side of the shop where they connect, by means of a breeches piece, to a permanent outside stack. These stacks are of mild steel and are being used to test various external finishes. The exhaust temperature, when the heat exchanger is not fitted, calls for a special treatment to the metal as some high-temperature paints rapidly peel off and leave an unpleasant appearance.

PROPANE AIR PLANT

High calorific value gaseous fuels are, of course, ideal for the operation of the gas turbine. Because of the increasing development of natural gas sources all over the world in the past few years and the obvious importance of the Ruston gas turbine in these areas, a plant has been installed at the Lincoln works to provide a mixture of propane and air, simulating the various gases which may be used at site. This has been met previously to some extent by the use of bottled methane, obtained, at consider-

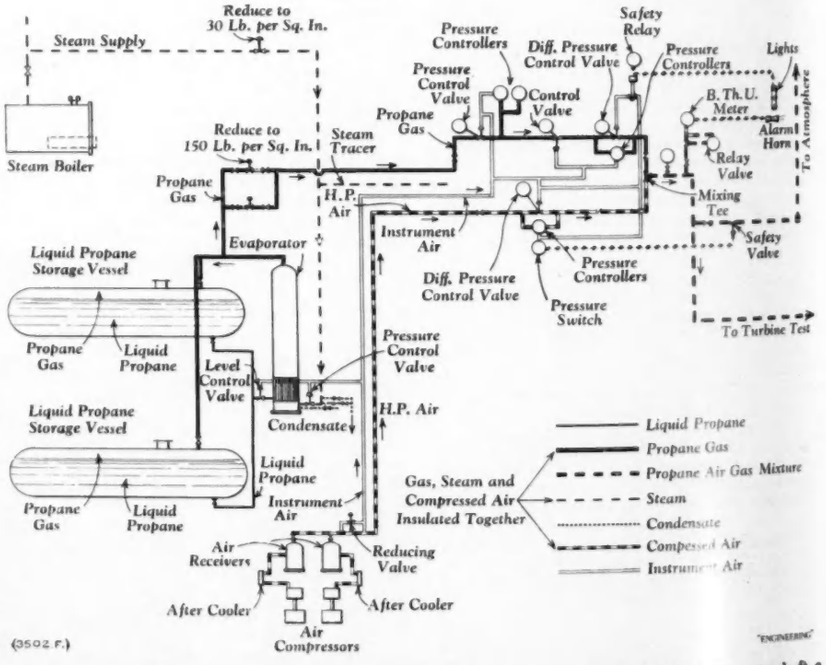


Fig. 4 To provide fuels for testing ranging in calorific value from 600 to 1,200 B.T.U. per cub. ft. a special propane plant has been built. Gaseous fuels corresponding to most of those in which turbines will eventually operate are thus continuously on tap.

able expense in relatively small quantities. To increase this type of supply to meet the test programme would have led to a large outlay without providing the desired flexibility. In the initial stages of running, modifications had to be made to the combustion chamber and settings of the A.G.I.P. (Italian) turbine. No methane gas was available in quantity in England and works tests could not include continuous running on the type of fuel available at site.

To overcome these difficulties, it was decided to build a plant in which suitable gas could be stored as a liquid in pressure vessels, to be drawn off, diluted with air, and passed to a turbine by way of a control panel. A gas was required that could be supplied in bulk and easily transferred to storage vessels. Propane was selected as being most suitable for this purpose. At ordinary atmospheric pressure it has a boiling point of − 42·2 deg. C (− 44 deg. F.) and can, therefore, be compressed easily to a liquid state for transport and storage. It has a calorific value of approximately 21,500 B.Th.U. per lb. and yields, on ideal combustion, only carbon dioxide and water vapour.

VARIABLE CALORIFIC VALUE

The plant will supply a gas mixture which can be delivered to the turbine test room with heating value adjustable between 600 and 1,200 B.Th.U per cub. ft., and employs Shell propane, brought to the works by road tankers equipped with transfer pumps. Each of the two storage vessels, of total capacity 25 tons liquid propane gas, is fitted with four relief valves interconnected so that at least two, which have adequate capacity to protect the vessel against over-pressure, are always locked in the open position. All pipelines entering or leaving the vessel are protected by excess flow valves or non-return valves located inside the vessels. Excess flow valves will shut off automatically when a dangerous quantity of gas or liquid flows away from the tanks, as in the case of pipe rupture. A rota-gauge on each tank provides a safe and simple method of gauging the contents. During filling an Ullage pipe indicates the maximum permissible liquid level, and Mobrey Trist float switches are to be fitted to give warning of over-filling by setting off an audible alarm.

During operation, liquid propane flows from the bottom of a storage vessel to the steam-heated evaporator after passing through a pneumatic control valve which is governed by a level controller on the evaporator. The layout of the plant can be seen in Fig. 4. The steam supply, delivered at a constant pressure, passes through a pressure control valve influenced by gas pressure in the evaporator and instrument air tapped from the compressor house to maintain the pressure in the evaporator and storage tanks. The vapour delivery is throttled, by twin reducing valves, to a constant pressure of 150 lb. per sq. in. gauge.

The compressor house contains two twin cylinder two-stage water-cooled air compressors, supplying high-pressure air, which, after passing through after-coolers, is delivered with the propane gas to the test shop. The air and propane lines run together, steam traced and insulated, to maintain a uniform temperature difference at the mixing station.

AIR PROPANE MIXING

The mixing station consists of a pneumatically operated automatic ratio control system with a rapid response to load variations. The air-operated controllers work on the principle of constant differential pressure across pneumatic control valves in such a way that, at each moment, both valves move an equal percentage of their stroke. The cone of each valve is shaped to obtain direct proportionality between valve position and valve through-put down to approximately 5 per cent. of the maximum flow. If the rate of consumption should fall below this value a blow-off line to atmosphere will open, blowing off gas until flow is once more stable. A sample of the mixture is reduced to a constant low pressure and burnt in a Sigma recording B.Th.U. meter. The gas and air, after having passed through the control valves, are mixed in a T-piece and the mixture is piped through an insulated steam-traced line to the turbine test beds.

Propane-air mixtures are non-explosive between wide limits. Should the mixture quality vary, however, the system is protected from within the B.Th.U. meter by an instrument provided with adjustable maximum and minimum contacts. If a contact is made a relay will cause the alarm horn to sound and solenoid valves will open. These will blow down instrument air pressure to the gas and air control valves, which will close, interrupting the flow to the mixing point.

SAFETY MEASURES

The storage tanks and evaporator are located within a fenced safety zone bearing no external combustible material. Electrical gear within the area is flame-proofed and the storage vessels are earthed to a point used also by visiting road tankers. A drencher spray system is to be fitted to the storage vessels. This installation, which is dry until started by a manually-operated switch from a remote point, will give protection against excessive heat. The principal risk within the building is a gas leak which could collect in the service trench network and form an explosive mixture. To counter this, ducting with spaced inlet grills is being provided in the trenches and attached to a centrifugal fan. Air is to be extracted at high velocity from the trenches and discharged above the building from a vertical stack, and any leakage of gas so entrained will be detected by a meter placed adjacent to the fan. A portable leak detector is supplied to check for gas concentration when turbines are coupled up or dismantled. The propane gas is odorised and exceptionally small quantities in the air can be detected, but to counter fire risk, portable chemical dry-powder fire extinguishers are available at each engine bed. It is primarily important to stop a leak or shut off the plant to prevent explosive conditions arising and an emergency drill has been designed to this end. Should a fire or serious leakage occur, emergency buttons in the shop will set in operation a sequence which will sound an alarm, shut down compressed air and steam supplies, and isolate electrically a predetermined zone in the works.

Apart from those already mentioned, the following contractors have contributed to the new installation:

Turbine test building: H. Smith, Ltd., Winsford, Cheshire (structural steelwork); W. Briggs and Sons, Ltd., Leicester (roofing); W. H. Heywood and Co. Ltd., Huddersfield (glazing); Burgess Products and Co. Ltd., Hinckley, Leicestershire (acoustic lining); the Winton Construction Co., Louth (foundations and floors); S. H. Heywood and Co. Ltd., Reddish, Stockport (overhead crane); Herbert Morris, Ltd., Loughborough (jib cranes); G. N. Haden and Sons, Ltd., Lincoln (heating); Matthew Hall and Co. Ltd., London, N.W.1 (piped services and electrical contracting); Keith Blackman, Ltd., Mill Mead-road, Tottenham, N.17 (trench ventilation).

Propane air plant: Comprimo N.V., Amsterdam C. (designers and main contractors); Matthew Hall and Co. Ltd., London, N.W.1 (pipework contractors); Holman Bros., Ltd., Camborne (air compressors); Short and Mason, Ltd., Walthamstow, E.17 (instruments); Fisher Governor Co. Ltd., Lewisham, S.E.13 (pressure control valves); Crosby Valve and Engineering Co. Ltd., Wembley, Middlesex (evaporator and level controller); Mather and Platt, Ltd., Manchester, 10 (drencher spray).

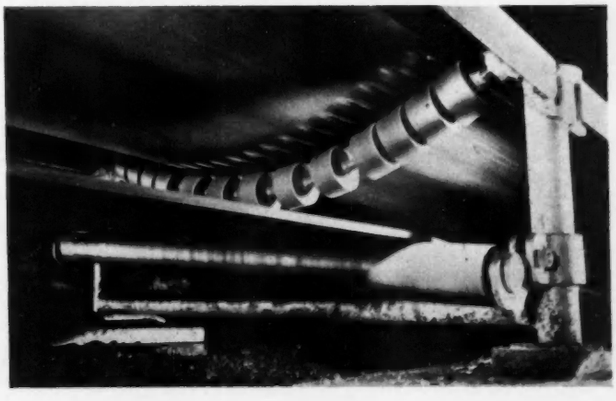
CONVEYOR BELT IDLER

Neoprene Rollers on a Flexible Support

Now being made in this country by Joy-Sullivan, Limited, Greenock, the " Limberoller " idler for belt conveyors is flexible and conforms to the shape of the belt. Basically, the idler consists of flexible steel cable, sheathed in Neoprene and suspended between two double-row ball bearings, on which are moulded Neoprene discs. This results in an idler only one-third the weight of one in steel with the same load capacity. The flexibility of the cable allows it to follow the load catenary of the belt, and so the load is spread over all the discs, reducing belt wear. The discs themselves have flat resilient support faces, and the material is more resistant to abrasion than steel. It is also resistant to attack by most chemicals, except very strong oxidising agents and aromatic hydrocarbons, and it will not support combustion. The illustration shows a Limberoller installed with a plain idler below for the return belt.

Two styles of stand are made to take the idler; one, available in two sizes, has a tripod base for floor mounting, and the other has brackets for mounting on conventional sections. The first can also be fitted to take a return idler if desired, and this type can be added to a conveyor without stopping the belt. The stand is simply pushed between the strands of the belt, rotated into the operating position and coupled to the next sections with stiffening rails. The ball bearings fit into standard mounting slots and are held in place with a spring clip, thereby enabling the idler itself to be changed if required—also without stopping the belt.

The position of the ball bearings is above the flow of material, and is therefore clear of the danger zone of abrasive and moisture attack. In addition, the bearings are fitted with Neoprene wiper seals on the inside, the edges of which run in annular grooves cut in the inner races and covered with cartridge type dustcaps on the blind side. The grease with which they are charged has a long shelf-life and a temperature tolerance of from − 35 deg. F. to + 275 deg. F. Due to the mounting position, any grease which may emerge from them will not foul the belt. The idler discs are self-cleaning as there is relative movement between them as they revolve. Also, since the idler is flexible, it will lift to allow any spilt material which has fallen on the return belt to pass below, and jamming is avoided. Therefore it is not necessary to fit decking between the loaded and the return belts. Three sizes are available, for belt widths of 24 in., 30 in. and 36 in., and there are two heights for the floor mounting stands, 13½ in. and 16 in. The headroom for a complete section can be kept to 15 in.



The Limberoller idler is made from a steel cable sheathed in Neoprene and fitted with moulded Neoprene discs. It has only one-third the weight of a steel idler and is more resistant to abrasion.

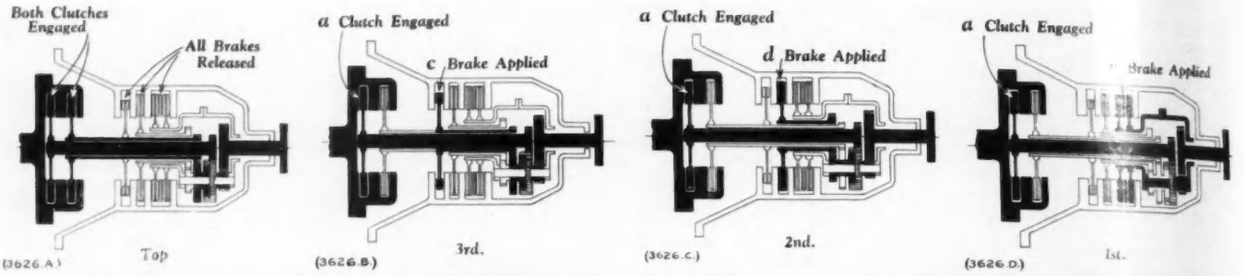


Fig. 1 The Hobbs automatic transmission comprises a planetary gear train and a set of oil-operated clutches and brakes which drive or hold various parts of the gear train to provide different ratios. The flow of oil to the clutches and brakes is controlled by a speed governor. The unit has been designed for road or industrial use. The sequence of gear positions is indicated here and on the facing page.

TRANSMISSION WITH AUTOMATIC GEAR CHANGE

PLANETARY SYSTEM HAVING HYDRAULIC CONTROL

In an article published last week we described a Diesel locomotive which is believed to be the first to be fitted with an automatic mechanical transmission. The Hobbs transmission has, however, been used elsewhere, in road and fighting vehicles, and is applicable to many types of industrial drive. Gear changes are effected automatically by means of a hydraulic mechanism controlled by a governor, and the weight, bulk, performance and fuel consumption is stated to be competitive with that of the synchro-mesh gearbox and clutch, which it has been designed to replace. It is claimed that the system gives simplicity of control, since only the throttle requires to be operated; added safety, particularly on down-hill running where gear selection is much simplified; reduced manual effort; and improved acceleration and performance generally. A description of the principles it employs is given in this article.

As can be seen from Fig. 1, the gearbox consists of a planetary gear train and a set of oil-operated clutches and brakes which drive or hold various parts of the gear train to provide different ratios. A governor valve is controlled by the pressure from an oil pump driven from the output side of the gearbox, so that its position varies with the running speed of the locomotive. The governor valve in turn directs the flow of oil from another oil pump (driven from the input side of the gearbox) to the relevant clutches and brakes for a particular gear ratio.

The hydraulic control is designed to give an overlap between the release of one gear ratio and the engagement of the next, so that continuity of traction occurs. Upward changes take place at higher speeds than the corresponding downward changes, avoiding the possibility of hunting between two gears on a gradient. By a device known as a "trafficating valve" the primary clutch is held in light engagement when the engine is idling and picks up the drive smoothly as the engine speed increases. There is also a "floating valve," the purpose of which is to open the annular actuating space associated with each clutch to an exhaust, so that when the clutch is to be disengaged the oil may be flung out and the space emptied. All clutches and brake surfaces run in an oil lubricated condition so that wear of linings is negligible. Pressure is applied by diaphragms of large area, with correspondingly low operating pressures.

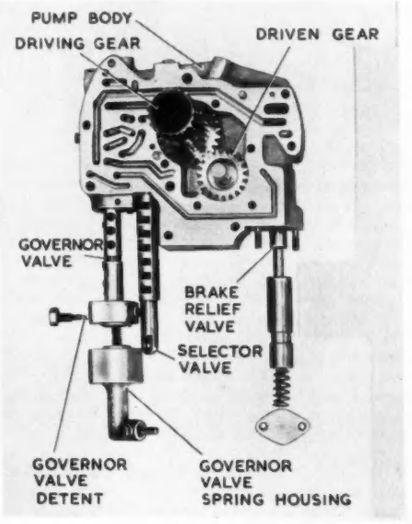


Fig. 3 Main component of the hydraulic control unit. The base is a shell moulding in which the oil portages are cast.

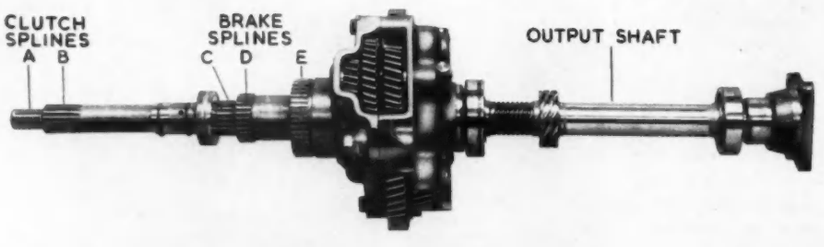


Fig. 2 Gear unit for motor car, showing input shaft and output shaft. The four sun wheels mesh with pinions mounted on spindles carried by the cage. One sun wheel is located on the output shaft, while the other elements of the gear train are connected to the clutches and brakes.

OVER-RIDING CONTROL

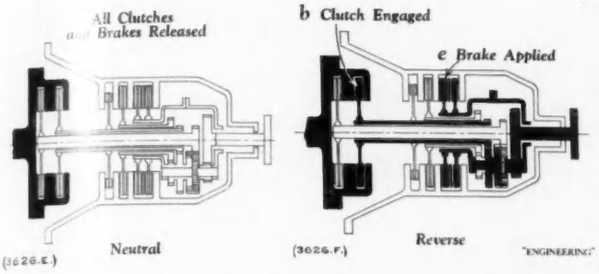
There are of course variations in design in accordance with the application involved. For road traction, there are the normal number of forward gears and a reverse gear, whereas in the Peckett Diesel locomotive there are four gears, forward and reverse. The transmission is in all cases provided with an over-riding control and a lever can be moved to give the various gear ratios manually, or automatic operation. Checks can be fitted when required to prevent engagement of lower gears or reverse when forward speeds are too great. However, in the case of the locomotive, the reverse gear can be selected before forward motion ceases.

The mechanism combines a number of standard units which can be discussed separately. A typical car gear unit itself, shown in Fig. 2, comprises a plantetary gear train having four sun wheels which mesh with pinions mounted upon spindles carried by the cage. One sun wheel is located on the output shaft, while the other elements of the gear train connect the spinner plates of the clutches and brakes. The different ratios are obtained by engagement of the various plates.

HYDRAULICALLY OPERATED CLUTCHES

The clutch unit is bolted to the engine flywheel and contains two hydraulically actuated friction clutches. The spinner plate of the front clutch is mounted upon a shaft and the spinner plate of the rear clutch upon a sleeve surrounding the shaft. Power may be transmitted to the shaft or to the sleeve, or part to each, by engagement of one or other, or both of the clutches. It should be noted that the clutches are not ordinary slipping clutches, in which wear might be excessive, for the faces are in fact separated by a column of oil until mating actually occurs. The brake unit is fitted into the transmission casing. The brakes are of similar construction to the clutches, and the parts may be of the same dimensions, thus simplifying manufacture. The spinner plates of the brakes, which serve to hold the various elements of the gearing stationary, are mounted on sleeves.

The hydraulic control unit, which appears in Fig. 3, is bolted to the front end of the brake unit and embodies a pump driven from the clutch unit to deliver oil under pressure when the engine is running; an automatically operating governor valve and a manually operated selector valve, which serve to direct the oil to the hydraulically actuated clutches and brakes as required; a brake relief valve and a clutch relief valve which maintain suitable pressures in the system; and a feed journal through which the oil is fed to the rotating clutch unit. The hydraulic control unit can be a shell moulding in which the portages are cast. These portages, which can be seen in the illustration, are an interesting feature of the design and serve to carry the hydraulic fluid to the appropriate brakes or



clutches; this method of fabrication simplifies manufacture and assembly.

GOVERNOR VALVE

Secured to the casing is the rear pump unit, which is driven from the output shaft so as to deliver oil under pressure when the shaft is rotating. This serves to supply hydraulic fluid for operating the governor valve, as indicated in Fig. 4, and for actuating the clutches and brakes when the engine is to be started by running down hill or towing. Thus the hydraulic unit includes a pump driven from the output shaft and one from the input shaft. A tow-start valve puts the output shaft pump in circuit when the input pump is stationary.

The delivery from the output pump is led to one end of the governor valve and can escape through a number of jets or restricted openings from the governor-valve bore. A spring acts on the other end of the valve. Some of the jets are closed or opened according to the valve position. At low speed, the delivery from the pump can escape through one jet, allowing the governor valve to remain at the end of its bore and so select the lowest gear. Rise in speed increases delivery and the resulting higher pressure moves the governor valve against the spring until a second jet is uncovered in which position the next gear is selected. Up and down changes are selected in accordance with increase or decrease in pressure due to changes in speed and the number of jets in operation. A "kick-down" valve, connected to the throttle pedal, when moved increases the size of the jets, and thereby the speeds at which the changes occur.

The power path diagram in Fig. 1 shows how the different ratios are obtained. Four speeds and reverse are provided and these are brought into operation merely by directing the oil pressure to the appropriate clutches and brakes. The clutch, *a*, is engaged for all forward ratios, and to change from one ratio to another it is only necessary to disengage one brake and engage another. In changing from third to fourth (directly), the brake, *c*, is disengaged and the clutch, *b*, engaged. There are no compound changes involving engagement of more than one clutch or brake at the same time. Clutch *b* is of smaller capacity than clutch *a* as it transmits only part of the torque in direct ratio. It is used for reverse, and the smaller capacity facilitates manoeuvrability.

PLANETARY OPERATION

Although the gearing is of simple construction with few gear wheels and bearings, the arrangement provides suitable ratios with moderate loads and unusually low tooth speeds. When operating in first and reverse ratios, the cage is held stationary and the pinions rotate on the spindles at speeds somewhat less than three quarters of engine speed. When operating in second ratio, the cage rotates slowly forward and the pinions rotate at about half engine speed. When operating in third ratio, the cage rotates faster and the pinions rotate at approximately one fifth of engine speed. When operating in fourth ratio, the cage rotates at engine speed and the parts of the gear train are relatively stationary. It is worth noting that when the output shaft is at rest and the clutches disengaged, the parts of the transmission are at rest. This eliminates the noise during idling which is associated with certain kinds of planetary or epicyclic transmissions.

Several versions and sizes of the gearbox are made, with minor variations to suit particular applications. Besides the designs for motor cars and locomotives, there are, for example, a number of models for public-service and heavy vehicles, one of these having five forward and two reverse speeds; there is also a five-speed unit with only two clutches and two brakes for cross-country and earth-moving vehicles. In addition, models can be made for marine and industrial purposes and controls may include means of inching and running at low speeds with continuous slip. The transmission is made by Hobbs Transmission Limited, Sydenham House, 78 Russell-terrace, Leamington Spa, Warwickshire.

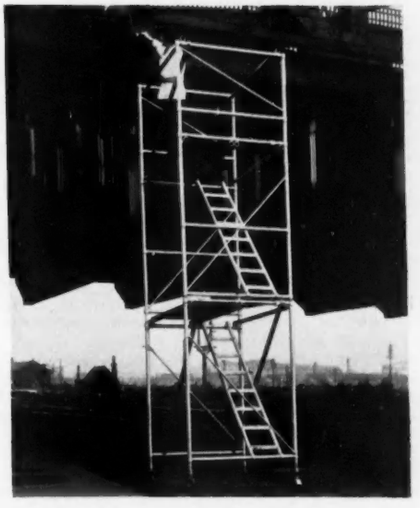
★ ★ ★

TUBULAR STAGING WITH QUICK LOCKING CONNECTIONS

Though maintenance jobs are frequently only a matter of a few minutes' work, the preliminary erection of staging may be a long and expensive task. To overcome this problem Access Equipment, Limited, Braemar-avenue, Neasden, London, N.W.10, have introduced a new quickly erected staging which they are to sell under the trade name of "Zip-Up." The company is a subsidiary of William Moss and Sons, Limited, the building contractors, and since 1950 has been responsible for introducing the "Beanstalk" working platform, as well as the "Erection" and "Safety Raiser" platforms.

The new "Zip-Up" staging is available in two forms: a storey type (as is shown in the accompanying illustration) and a span type, in which bracing members have been eliminated from the lower frame, so that the staging can straddle work benches, machines or other fixed equipment.

The stagings are built from light-alloy tubes and are distinguished by three new features. The first of these is a very simple locking hook that permits the quick connection of members, which are held in position by a spring-loaded stud easily released when the staging is to be dismantled. The second feature is the use of vulcanised rubber castors which incorporate a simple pedal brake; operation of the brake depresses a hood on to the wheel so stopping any rolling motion, and simultaneously eliminates the swivel action of the castor. The third feature is a novel adjustment of height built into the legs of the bottom frame, just above the castor. The post of the castor unit is threaded and fits into the vertical tube of the frame; this tube is threaded internally and split so that it can be moved along the post without twisting. When the corrected adjustment has been made, a collar is pushed down the split tube which is closed so that the leg of the frame is safely locked in position. This allows each leg to be independently altered by as much as 2 ft. in its length, so enabling the staging to stand firmly on an uneven surface. These three features are common to both types of staging, but there is another which relates solely to the stairway type. This is the single-pressing tread used for the built-in ladders; in this type of pressing, the manufacturers believe that they have produced the ideal non-slip tread.



Light-alloy tubes, pre-assembled into box frames and with quick-locking connections, have been used for this staging. The unit shown can be erected in two or three minutes.

The floor boards used are of a resin-bonded ply, each with four lugs which fit into holes in the members of the floor frame. The boards are secured by spring clips.

The principal claims put forward for the new staging by the makers are those of mobility and security for the men when working at height. Climbing the staging is easy as there is always a secure hand-grip within easy reach. The stairway version provides platform areas of 6 ft. by 4 ft. at intervals of 6 ft. in height, and an optional intermediate platform reduces this interval to 3 ft. Combined with the adjustable-leg fitting immediately above the castor, platform levels can be varied to suit most requirements in respect of working height.

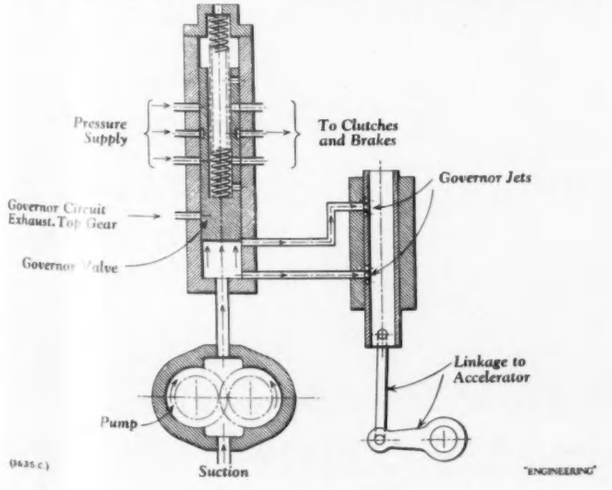


Fig. 4 Oil is delivered from a pump driven by the output shaft to one end of a governor valve and can escape through a number of openings from the valve bore. Oil is thus directed to the appropriate clutches or brakes in accordance with the valve position.

HARWELL REVIEW

Last week a series of Open Days were held at the Atomic Energy Research Establishment, Harwell, during which visitors were able to see work covering the first 10 years of the Establishment's activity. This week, therefore, instead of our customary "Atomic Review," we shall describe some of the items exhibited on that occasion. A review of Harwell's past achievements alone would be of interest only to the historian; we shall therefore endeavour to concentrate in this article on those items which may provide some indication of the future. Comments on the Establishment's work are made in a Weekly Survey note.

Power Reactor Prospects

It was stated at a Press conference held during the Open Days that the PIPPA type reactors, such as those at Calder Hall, would be succeeded in this country by reactors employing either the pressurised-water system or the sodium-cooled graphite-moderated system. Unfortunately, as yet, no economic method of constructing fuel elements for the pressurised-water reactor has been devised. Moreover, the initial Soviet reactors which are based on this system, were described disparagingly as "uranium 235" burners. In addition to these studies work is being performed on various advanced reactors. ZEUS, which can be seen in Fig. 1, is used for studying fast reactor breeding characteristics; and research is also being carried out on the homogeneous thorium-uranium 233 system. This research is concerned with hydraulic cyclones for slurry particle separation, particle analysis, gas separation and the preparation and properties of thoria; problems of gas processing involve the recombination of deuterium with oxygen to form heavy water.

LIFT PUMP FOR BISMUTH

Though no liquid-metal fuelled reactors have been built, test loops carrying liquid plutonium or other metals are or will shortly be under investigation. The use of liquid bismuth as a solvent for reactor fuels to permit operating temperatures of from 600 to 800 deg. C. has also been examined, and a nitrogen-gas lift pump has been designed for circulating liquid bismuth. In a model system demonstrated, the piping was of silica but in a full-scale plant corrosion inhibitors would be used on the interior of the pipes, since bismuth at high-temperatures is a highly corrosive agent. The pump is probably the first of its kind to be built in this country. In a reactor using a bismuth slurry, fuel enriched with plutonium or uranium 233 would be employed together with a honeycomb graphite moderator; the system would not therefore be homogeneous in the reactor sense. The advantages of liquid metal reactors include the rapid dispersal of fission products, which come off mainly as volatile gases; the elimination of metallurgical problems associated with the crystalline structure of solid fuel elements; and ease of fuel processing. Corrosion problems, however, are serious.

The helium-cooled reactor driving a gas turbine in closed circuits appears to be in favour. Helium gas was stated to be cheap enough to make such systems economic. It is interesting to note that gas-lubricated ball and socket joints are used in the remote handling devices for shielded experimental chambers; this principle is also likely to find an application in the bearings of a helium turbine. Another system on which comment seemed favourable was that employing an organic liquid, such as diphenyl, as moderator. Dr. J. V. Dunworth considered that a stable liquid could be found for this purpose.

SHIELDING AND MATERIALS TESTING

Much information for future reactors of these and other kinds will be obtained from the heavy-water cooled and moderated materials testing reactor DIDO, the interior of which prior to completion is illustrated in Fig. 2, and PLUTO, an engineering test loop reactor now being built and due to be completed by the middle of 1957. LIDO will provide data on shielding, and is evidence that work is being carried out on reactors for aircraft and ships, where the shielding problem is probably the major one. It is an enriched-fuel light-water moderated, reflected and cooled reactor and should be finished by September.

Materials

Fuel for the second stage reactors (see Weekly Survey) will probably be enriched with plutonium made available from the earlier piles. The properties of plutonium are therefore an important consideration and work on this subject is being carried out in the "alpha wing," so called because materials emitting only the comparatively short-range alpha radiation are studied there. Plutonium has five principal phases, known as α, β, γ, δ ϵ, and gives rise to structural problems as a result of expansion. At 350 deg. C. it enters the δ phase where the lattice is face-centred cubic and at 500 deg. C. the ϵ phase, in which the lattice is body-centred cubic; plutonium is therefore most easily worked in the neighbourhood of these temperatures.

EFFLUENTS AND FUEL PROCESSING

The problem of effluent disposal will increase greatly as the atomic energy programme develops. Attempts are being made to develop a system whereby the actual discharge is reduced to a minimum. Highly active wastes will be converted to solids which may be safely stored. Low-activity wastes, comprising the bulk of the effluent, will be treated chemically, then decontaminated further in soil beds, and finally passed through an electrolytic unit. Using a demineralised water supply it is hoped to produce a final effluent which can be recycled. Such a scheme is also economical in water consumption.

Processing of reactor fuel elements is required to repair irradiation damage and to remove fission products which absorb neutrons. The cost of processing is a substantial fraction of the cost of nuclear power. The work at present in progress is aimed at reducing the processing cost. In existing processes the irradiated fuel element is dissolved in acid, the fission products are removed by solvent extraction and the fuel element is refabricated. To avoid the expensive metal to solution to metal stages, high temperature metallurgical processes are being developed. The fuel is kept in the metallic state, and melting, slagging and vaporisation techniques are used to remove neutron absorbers. Fuel element fabrication is still required.

Fabrication techniques for many of the metals of major interest in reactor construction were

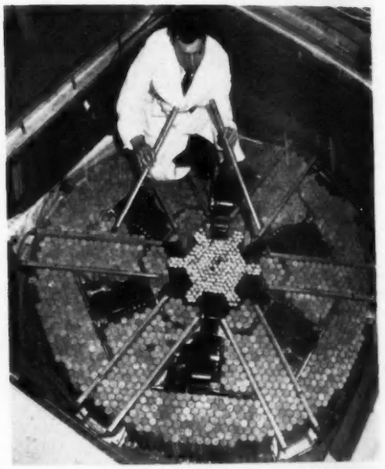


Fig. 1 ZEUS is a fast reactor with an enriched uranium core. It will be used for testing the breeding characteristics of reactors similar to that now building at Dounreay, but will have aluminium and magnesium castings replacing the liquid sodium coolant.

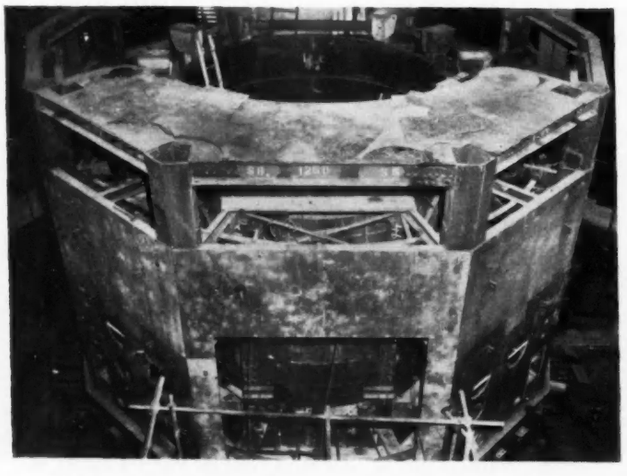


Fig. 2 Interior of DIDO during construction. It will be a materials testing reactor and is due to be completed in August.

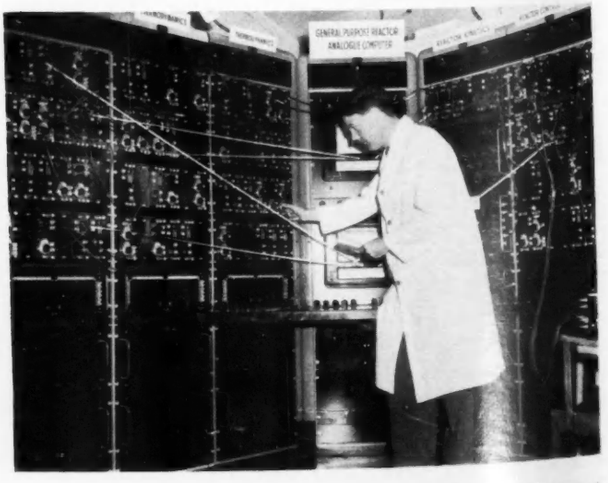


Fig. 3 "Re-canning box" with lead shielding in which fuel elements are re-canned by an operator using remote handling devices.

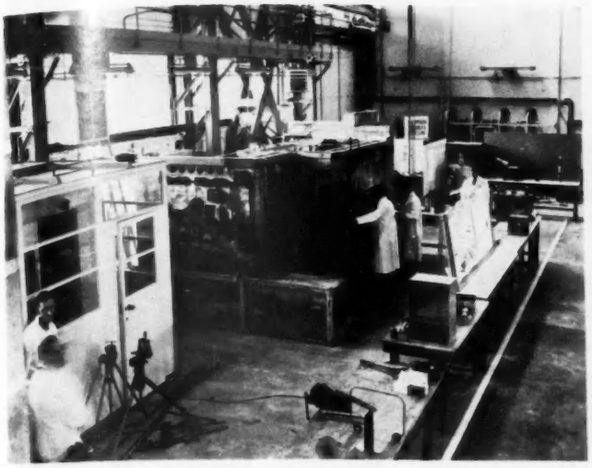


Fig. 4 "Hotspur Suite" used for high-temperature processing of reactor fuel.

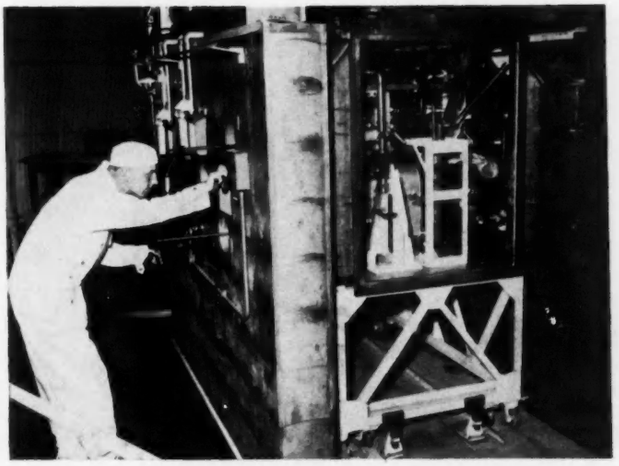


Fig. 5 Analogue computers serve to simulate reactor systems or complete power plants.

relatively undeveloped before the advent of nuclear power. Such metals include the basic fuel uranium, the breeder material thorium, zirconium, a canning material, and beryllium, both a moderator and a canning material. In addition the refractory compounds of some of these metals, for example, the oxides of uranium, beryllium and thorium, and uranium carbide, are of interest where very high temperatures are encountered in service conditions.

Techniques

To cover all the techniques in use at Harwell would be a hopeless task, but it may give some idea of the range to mention only a few. The problem of dealing safely with radioactive materials presents a considerable difficulty and radiation shielding, enclosed boxes and remote handling facilities are common to most departments. Fig. 3 shows a "re-canning box" surrounded by lead walls as protection against beta-gamma activity with the side cover removed to show the interior. Fuel specimens are re-canned by the operator for further irradiation. The "Hotspur Suite" illustrated in Fig. 4 is used for high temperature processing of reactor fuel.

Harwell possesses what is believed to be the largest electromagnetic separator in Europe, which is used for providing isotopes of all the elements up to uranium. The material to be separated is produced as an ion beam, and this passes into a magnetic field where the isotopes of various masses are deflected to different extents so that they can be caught in separate collections. The ion beam is 100 mA at 30 kV and the unit is a 180 deg. mass separator of 2 ft. radius. The magnet weighs 400 tons and gives a field up to 6,000 gauss, uniform to 1/5,000.

TRANSISTOR COMPUTER

Apart from a variety of standard electronic equipment, the Atomic Energy Research Establishment makes wide use of computer techniques. Analogue computers incorporating hydraulic and mechanical elements may be employed as reactor simulators able to represent any reactor system or to study the kinetic behaviour of a complete power plant. In this way many problems presented by untried reactor schemes can be solved economically without the expense of building prototypes. Fig. 5 shows an analogue computer being operated.

Digital computers are also valuable research tools and "CADET" is a computer of this kind employing transistors. Compared with thermionic valves, transistors have the advantage of low operating voltages and power consumption, compactness and potential reliability. The model shown has 320 transistors and no thermionic valves, and requires a power consumption of only 70 watts. Numbers and instructions are fed into the computer on punched cards, and are stored on a magnetic drum store with a capacity of more than 500,000 binary digits. The computer can be used for an almost unlimited range of tasks, provided they require only the basic operations of addition and subtraction.

A new high-powered accelerator is to be built at Harwell. This will be used for fundamental research and it is hoped that it will serve as an attraction to scientists who are anxious to pursue advanced studies.

* * *

CORROSION AT BIMETALLIC CONTACTS

Elimination by Good Design

Information on "Corrosion and its Prevention at Bimetallic Contacts," compiled by the Admiralty and Ministry of Supply Inter-Service Metallurgical Research Council, is contained in a pamphlet, price 1*s.* 6*d.*, net, published by Her Majesty's Stationery Office. It is intended for designers in Government departments and contractors, but it is felt that the data should be of considerable interest and value to all persons concerned with metallic corrosion.

The text provides general information concerning the conditions in which bimetallic contacts are most likely to lead to troublesome corrosion and also regarding the means of mitigating such effects. A table is provided in which, by a system of symbols, the relative effects on the corrosion of a range of metals, when brought into mutual contact and bridged by water containing an electrolyte, are indicated.

It is emphasised that the most effective methods of corrosion prevention lie in careful design and the adoption of sound assembly practices. The recognation of bimetallic corrosion risks, from the outset, will enable a designer to avoid dangerous contacts where possible; to avoid water-collecting pockets around unavoidable contacts; to build in adequate ventilation and drain holes; and to make due provision in the initial design for the use of recognised protective measures.

It is further pointed out that dissimilarity may be avoided, by coating one metal (preferably the cathode) with the other metal that is compatible with it. Thus, in airframe assemblies for service aircraft, it is mandatory that such components as bolts, screws, pins and bushes made from stainless and other steels should be cadmium plated whenever they are used in contact with an aluminium or magnesium-rich light alloy. Cathodic protection is particularly applicable to counteracting immersed corrosion, but can be applied sometimes to combating atmospheric corrosion. Thus, for instance, zinc washers may be useful when steel bolts are used in an aluminium-alloy structure. Non-metallic coatings are effective in particular cases. Thus the anodising of aluminium alloys is useful in moderate conditions, or may be used to contribute to the precautions adopted.

A point to remember is that chromium, stainless steel, titanium and aluminium develop highly protective oxide films and behave as relatively noble metals under conditions favourable to the maintenance of such films, these conditions being dependent upon the continuous presence of oxygen. In conditions in which a breakdown of the films is feasible, however, they are less resistant to attack.

* * *

PRODUCTIVITY IN HOT-DIP GALVANISING

A review of productivity in the general galvanising industry of the United States, based on a study made by Mr. A. G. Northcott, industrial engineer to the Hot Dip Galvanisers Association, has been published by them as a 70 page report "Productivity in Hot Dip Galvanising" (price 7*s.* 6*d.*).

Mr. Northcott's report is based on a study of some 20 galvanising plants and he makes a number of proposals for improving productivity in the United Kingdom galvanising industry.

In the first place it is suggested that the Association's technical committee could prepare a concise "Code of Practice" giving technical guidance to general galvanisers.

Secondly, the Association's productivity committee could launch a good housekeeping and safety campaign.

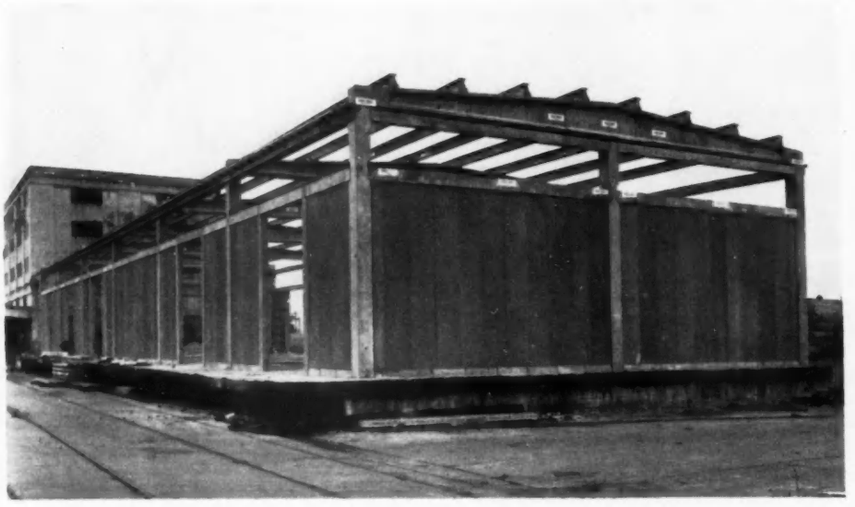
Thirdly, the Association could introduce a cost and performance comparison scheme which would focus attention on costs and the need for cost reduction.

Fourthly, a committee could be set up to discuss the advantages of greater specialisation.

Fifthly, the Association could urge their members to make greater use of local and national facilities for the training of supervisors.

In the sixth place managements should concentrate on improving the continuity of the flow of work, since this is the key to productivity.

In the seventh place, in order to become familiar with the advantages, purpose, scope and limitations of work study, managements should take advantage of the many courses available, and that they should consider seriously the possibility of mechanising the flow of work through all stages, including dipping. The last proposal suggests that managements should obtain, from an impartial source, a report on the effectiveness of their own incentive schemes.



Figs. 1 and 2 One of the problems of large pre-cast concrete structures is the choice of cladding. Cellular prestressed slabs are one solution and have at least the advantage of providing a dead-weight resistance to overturning by wind load.

PRE-CAST CONCRETE WAREHOUSES

A rapidly increasing method of warehouse construction is that employing the factory-made pre-cast prestressed concrete unit. This form of construction has many obvious advantages. The buildings should require only little maintenance for as nowhere are materials left exposed which are affected by atmospheric conditions, as by design all fixings of units are incorporated in the construction of the unit, and where bolts are used provision is made for sealing by pressure grouting. In addition, decoration is reduced to a minimum, as colour can be cast into the facing units to give a permanent finish or, alternatively, special natural finishes such as white spar, exposed aggregate, or patterned imprints can be used.

In recent years, Dow-Mac (Products) Limited, of Tallington, Lincolnshire, one of the Dowsett Group of Companies, has developed this form of construction to a high degree, and the company are at the present time undertaking the design, production, supply and erection of warehouses in many parts of this country. The standard Dow-Mac warehouse employs reinforced concrete columns varying from 15 ft. to 50 ft. long. They are usually erected by a mobile crane, and are located in hollow base sockets up to 4 ft. deep. After plumbing they are temporarily fixed with prestressed concrete packers and steel folding wedges, after which grout (followed by concrete) is run into the bases; the wedges are withdrawn after the concrete has set. Where necessary, prestressed piles are used under the bases.

Main bearer beams may be up to 80 ft. 0 in. in clear span. They are provided with a horizontal soffit but a decrease of their depth towards the supports provides a satisfactory fall to the roof. The largest members are prestressed with 100 wires 0·200 in. in diameter, and in all cases the beam ends are located on the column tops by bolts and nuts cast *in situ*. The frames, which are spaced at centres of up to 30 ft., are connected by purlins, eaves units, side members and valley gutters, all in prestressed concrete. The columns have suitable shoulders to receive these members and the main bearer beams for the first floor; the secondary beams in these floors are of a similar section to the roof purlins. When required, prestressed concrete crane beams up to 30 in. by 15 in. in section can be supplied to carry overhead cranes of 10 ton capacity on a 30 ft. span. The interior of an engineer's shop constructed in this fashion is shown in Fig. 4, opposite.

Roofing for these structures can be asbestos-cement reinforced troughing sheets, with roof lights suitably spaced to augment lighting from standard windows or "Perspex" glazing in the side walls. An alternative form of roofing is provided by the Dow-Mac hollow beam, 14 in. wide, which is available in spans up to 50 ft. and from 4 in. to 14 in. in depth. A similar version of this beam is also available as a flooring unit. Side cladding in these warehouses is frequently constructed from prestressed concrete slabs 3 in. thick and measuring 9 ft. by 2 ft. 6 in., as shown in Figs. 1 and 2 above. The weight of the concrete has at least one advantage in that it provides a resistance to the overturning effects of the wind.

The advantages to be obtained from using factory-made concrete members are standardisation of moulds, and the quality of workmanship possible with the close supervision available under factory conditions. Delivery can be scheduled with the object of achieving a minimum of working space required on site; the small site labour force also results in an overall economy of construction. Possibly the greatest advantage lies in speed of erection, and it is noteworthy that experience has shown that six men have no difficulty in erecting the framework of these buildings on previously prepared foundations at a rate of 9,000 sq. ft. a week, to an average roof height of 30 ft. Three main erectors are followed by others grouting the structural members; further small teams of men hang the concrete wall slabs and side cladding.

A second type of standard warehouse building of a smaller size is also made by Dow-Macs. It is supplied in lengths from 21 ft. on a module of 7 ft. 0 in. and with a span of 28 ft. The outstanding feature of the building is the roof, which is entirely of concrete and is erected in units 3 ft. 6 in. wide, each unit consisting of two panels pitched at 22½ deg. and a prestressed concrete tie, pin-jointed together to form a three-pin arch construction, as shown in Fig. 3. The panels are ribbed and reinforced, and are rebated at the edges for a patent joint which ensures weather proofing. A ridge unit completes the roof and at the ends of the building the barge units and finial make a feature.

The walls consist of column units 2 ft. 2¼ in. wide at 7 ft. 0 in. centres, with infilling panels 2 ft. 0 in. deep to suit standard eave heights of 8 ft., 10 ft. and 12 ft. The walls are finished by an eaves unit suitably jointed, and a similar unit follows through the gable. The arrangement makes it possible to provide a window or door in every 7 ft. 0 in. panel and, by the omission of a column and substituting a deepened eaves unit, it is possible to provide a door opening approximately 12 ft. wide. Gables are completed in column and panel units of a shape varied to suit the roof inclination of 22½ deg.

The system naturally lends itself to multi-bay construction to an unlimited extent, laid out on ridge centres of 30 ft. 10 in. The units

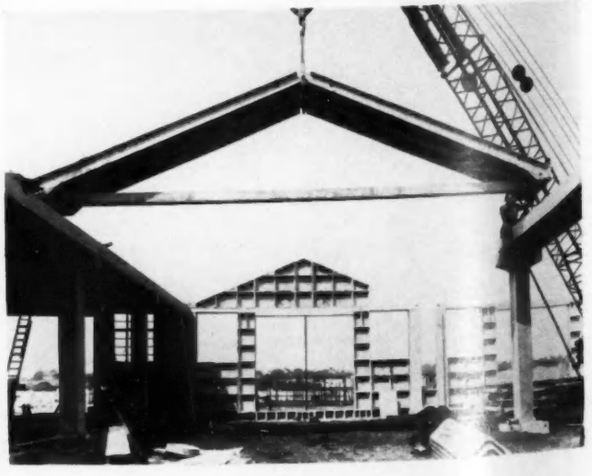


Fig. 3 Prefabricated three-hinged roof unit of 28 ft. span. The tie is of prestressed concrete. This standard building is designed on a module of 7 ft. and is available in any length from 21 ft. by multiples of 7 ft. The design readily admits multi-bay construction.

required in addition to these are internal columns, prestressed concrete valley gutters and special gable panels at the bay junctions. These structures have the same advantages as the larger type of warehouse, and it is claimed that they should have a longer life than brickwork or *in-situ* concrete. They have an external appearance which is pleasing and avoids the worst features of some prefabricated constructions.

The same principle of rapid erection applies to these buildings as for larger warehouses, and a rubber-tyred crane of 3 to 6 tons capacity with a 30 ft. to 45 ft. jib is used with three erectors. The crane off-loads the units from the road vehicles by which they are delivered, erects the

Fig. 4 Interior of an engineering shop with asbestos-sheet wall cladding and roofing and standard glazing.

walls of the buildings to eaves level and assembles the three-hinged roof structure. After this erection the only work which remains to be done is fitting doors, window-frames and gutters, glazing, painting and sealing of roof joints with a patent strip. A team of six men will complete 300 sq. ft. of finished building a day on prepared foundations.

SETTING A WORK-TABLE QUICKLY

ELECTROMAGNETIC SYSTEM WITH ALTERNATIVE PUNCHED-CARD OR MANUAL CONTROL

One of the main expenses in the initial stages of production is often the development and manufacture of special jigs to give the accurate machining of the final part. Jigs are both costly and time-consuming in production, and their abolition is therefore a considerable step towards cheapening and speeding output. To achieve this end the British Thomson-Houston Company, Limited, Rugby, have developed an automatic co-ordinate setting equipment for use with a horizontal boring machine. The equipment has been produced in co-operation with the makers of the machine, H. W. Kearns and Company, Limited, Altrincham, and the first commercial installation has been made at the Leicester factory of the British United Shoe Machinery Company, Limited. The machine is shown in Fig. 1. The co-ordinate setting mechanisms are built into a separate control desk which is shown in Fig. 2.

The machine has both horizontal and vertical movements, and the slides can be set to any position by the knobs on the control desk. Each ordinate is made up of six digits giving accuracy to 0·0001 in. For a single operation the work is positioned by direct setting of the knobs but, where batch or short run production is required, provision has been made for a card reader which will take punched cards; one card is required for each position, and therefore there must be a set of cards for each work piece.

The machine is a No. 0 horizontal boring machine (planer table type) to which have been added power servos and a built-in measuring system for the automatic control. The horizontal traverse is 57 in. and the vertical movement 42 in. The main bed is 10 ft. long and carries a table measuring 3 ft. by 6 ft. On the main table is mounted a revolving table, 3 ft. square, of cellular construction. A range of 16 reversible speeds is available for the 3 in. diameter spindle, and can be selected by the use of two levers. Two complete ranges of feed are available, one driven from the spindle sleeve and the other from the first motion drive shaft which gives eight feeds independent of the spindle speed. The gearbox, which is mounted direct on the end of the main bed, provides the drive for automatic positioning and gives an infinitely variable range of feeds from ½ in. to 10 in. per minute, and also a high-speed traverse at the rate of 120 in. per minute. The control pendant carries ten push buttons, three of which control the main spindle motor, three the inching mechanism for the transverse movement of the table and the start of automatic positioning, and three for the smaller vertical movements of the spindle slide, whilst the last stops the spindle slide and table movement.

In order to ensure the holding of the slide when it has reached its required position, hydraulic clamps automatically go into operation; a wedge lined and bushed with plates of PTFE clamps on to the slides and grips them.

CALIBRATED BAR

The operation of the co-ordinate setting mechanism is shown in the diagram, Fig. 3;

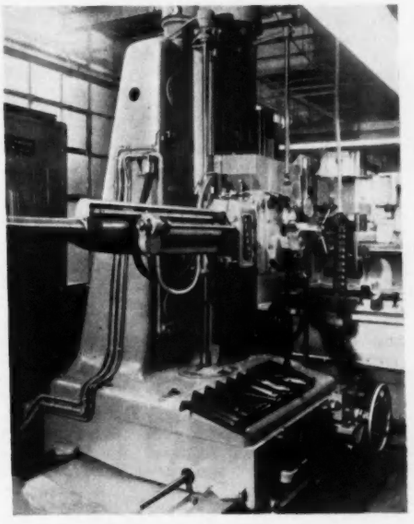


Fig. 1 Working from chosen (and adjustable) datum lines, the workpiece is located on the boring machine by setting co-ordinates on dials.

Fig. 2 Each co-ordinate consists of six figures and can be set by hand or from a punched card.

NOTICES OF MEETINGS

Association of Supervising Electrical Engineers

LONDON
Annual General Meeting. Central London Branch. St. Ermins Hotel, Caxton-street, Westminster, S.W.1. Mon., June 11, 6.15 p.m.
Annual General Meeting. West London Branch. Windsor Castle Hotel, King-street, Hammersmith, W.6. Tues., June 12, 7 p.m.
Annual General Meeting. South West London Branch. Guild House, Worple-road, Wimbledon, S.W.18. Wed., June 13, 7.15 p.m.

BIRMINGHAM
Annual General Meeting. Birmingham Branch. Chamber of Commerce, 95 New-street, Birmingham. Wed., June 13, 6.30 p.m.

BOURNEMOUTH
Discussion meeting with the Electrical Association for Women. Grand Hotel, Bournemouth. Tues., June 12, 7.15 p.m.

HALIFAX
Annual General Meeting. Halifax Branch. Crown Hotel, Horton-street, Halifax. Wed., June 13, 7.30 p.m.

LUTON
Annual General Meeting. Luton Branch. Midland Hotel, Williamson-street, Luton. Tues., June 12, 7.30 p.m.

OXFORD
Annual General Meeting. Oxford, Reading and District Branch. Y.M.C.A., 10 George-street, Oxford. Sat., June 16, 7 p.m. (Alteration of date).

WEMBLEY
Annual General Meeting. North West London Branch. Century Hotel, Forty-avenue, Wembley Park. Mon., June 11, 7.30 p.m.

YORK
Annual General Meeting. York Branch. Shambles Café, York. Wed., June 13, 7.15 p.m.

Building Centre

LONDON
Gas Council Film Display "Keep it Clean." Wed., June 13, 12.45 p.m.

Institute of Metals

LONDON
"Some Recent Studies of Irradiation Effects in Metals and Other Solids," by Professor R. Smoluchowski. Institution of Naval Architects, 10 Upper Belgrave-street, S.W.1. Wed., June 13, 6.30 p.m.

Institution of Civil Engineers

LONDON
Conversazione. Wed., June 20, 7.45 p.m.

Institution of Mining Engineers

EDINBURGH
Summer Meeting:
"Problems of Coal-Face Mechanisation in the Scottish Coalfield," by Dr. J. H. Paterson and H. H. Wilson, at 11 a.m.
"A Study of British and Continental Methods of Colliery Blasting," by R. F. McCormick and Dr. R. Westwater, at 2.30 p.m. Freemasons' Hall, 96 George-street, Edinburgh, 2. Wed., June 20.
Various visits and excursions. Thurs. and Fri., June 21 and 22.

Royal Meteorological Society

LONDON
"The General Circulation of the Atmosphere: A Numerical Experiment," by N. A. Phillips. Wed., June 20, 5 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this column should reach the Editor not later than Monday morning in the week preceeding the date of the meeting.

*** An asterisk is placed where it is understood that tea is available prior to the time stated.**

Association of Supervising Electrical Engineers, 23 Bloomsbury-square, London, W.C.1. (LANgham 5927.)
Building Centre, 26 Store-street, London, W.C.1. (MUSeum 5400.)
Institute of Metals, 4 Grosvenor-gardens, London, S.W.1. (SLOane 6811.)
Institution of Civil Engineers, Great George-street, London, S.W.1. (WHItehall 4577.)
Institution of Mining Engineers, 3 Grosvenor-crescent, London, S.W.1. (BELgravia 3691.)
Royal Meteorological Society, 49 Cromwell-road, South Kensington, London, S.W.7. (KENsington 0730.)

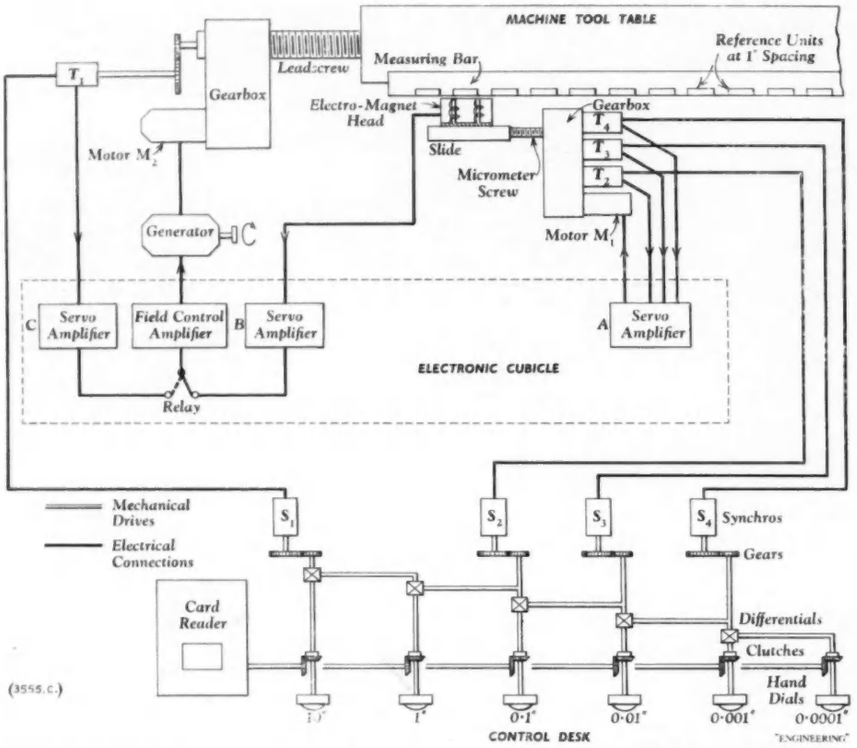


Fig. 3 Diagram of the control system for the horizontal movement. The differentials are included to avoid ambiguity in setting up. The control of the vertical movement requires an identical system.

all table movements are measured by a reference bar which is accurately divided into 1 in. units by holes spaced 1 in. apart along its length. This bar is mounted on the table of the machine and can be regarded as providing accurate measurement of the " integral inches " portion of the co-ordinate, while an electromagnetic sensing head mounted on the bed of the machine acts in conjunction with the bar to give the decimal part of the co-ordinate. The measuring bar is shown in Fig. 4 and is built up of the inch units which are identical blocks with a $\frac{3}{4}$ in. diameter hole in the face. In order to present a smooth surface the holes are filled with brass inserts. The bar is set up in a temperature controlled room so that the reference holes are $1{\cdot}000 \pm 0{\cdot}0002$ in. apart. A final screwdriver adjustment is provided which, through the medium of an assymetrical steel slug in the bar, allows the effective magnetic position of each hole to be shifted by $\pm 0{\cdot}0005$ in. The final adjustment is usually left until the bar is in position on the machine.

The electromagnetic head is essentially a differential arrangement of two transformers, the magnetic circuits of which are completed by that part of the measuring bar which faces the head. The construction is symmetrical so that it is not affected by temperature, supply voltage, frequency variations or stray magnetic fields. The gap between the magnetic head and the bar is not critical. The sensitivity of the head is such that it is capable of delivering a sufficient voltage to operate the servos with a misalignment of 20 micro-inches from the magnetic centre of one of the reference holes in the bar. The head carries oil-filled pad wipers which clean the face of the measuring bar as it passes.

APPROACH FROM ONE DIRECTION

The sequence of operations in setting up a co-ordinate is as follows (although described as a sequence, some of the motions take place simultaneously). The six dials for each ordinate are first set to the required figures, causing the " input " synchros S_1 S_2 S_3 and S_4 to be rotated; this then gives misalignment signals in co-operation with the corresponding output synchros T_1 T_2 T_3 and T_4 (Fig. 3). The decimal dimension is defined by the shaft rotation of S_2 S_3 and S_4 which causes the servo amplifier A to operate motor M_1 until the three synchros are in alignment. The motor M_1 moves the electromagnetic head through the corresponding decimal dimension by means of a very accurate micrometer screw.

The integral part of the desired co-ordinate gives a rotation of synchro S_1 which is interconnected with synchro T_1, which in turn is geared to the lead screw of the table. A misalignment signal from S_1-T_1 controls the servo amplifier C and through the motor M_2 brings the table to within about 0·2 in. of the desired position. The traverse speed is maintained at about 120 in. per minute until the table is within an inch or two of the desired position, when it is progressively reduced. The control of the motor M_2 is then transferred by way of servo amplifier B to the electromagnetic head. The control signal from the latter drives M_2 until the poles of the magnetic head are aligned opposite the nearest hole in the bar, under which conditions the error signal is zero.

During the approach to alignment under the control of the electromagnetic head a temporary misalignment signal is injected into the servo amplifier B, so that the table travels to a " false alignment position " approximately 0·020 in. from true alignment. The temporary signal is then automatically removed and thus the final approach to alignment is always from the same direction. This eliminates the effects of backlash in the machine.

After the setting of the digit dials the automatic setting of both co-ordinates on the machine tool is initiated by push buttons and the sequence ends by the automatic clamping of both motions.

In order that there shall be no ambiguity as to which of the inch reference units should be located against the measuring head a system of differentials connects the control knobs. These add one-tenth of the rotation of any dial to that of the dial on the left-hand side. This arrangement is necessary because there is a fixed relationship between the rotors of T_2 T_3 and T_4 through a normal gear train and the same apparent relationship must therefore exist between S_2 S_3 and S_4. It would not be satisfactory to gear the dials together directly for then the right-hand dial would need to make 1,000 revolutions for every inch change of setting.

ADJUSTABLE DATUM LINES

As has been mentioned before, the machine has been adapted for use with a punched card system and the card reader can be seen on the left of the control desk. The cards are the standard size used for business but they are made of a material impervious to oil. In operation, a card is taken from the stack and placed on the carriage; a " start " push button is pressed which causes the carriage to draw the card into the reader while the setting dials are simultaneously returned to zero. The carriage then reverses its direction of movement and brush contacts are lowered on to the card. As the card returns to the start position the dials are rotated in unison; when an electric circuit is completed through a hole in the card the appropriate dial is disconnected from the mechanism and is left accurately positioned by means of a detent wheel. The datum lines on which the co-ordinates are based are shown on the blueprint for the workpiece and are chosen to be convenient for the particular item. To simplify the setting up procedure, the device includes a means for quickly changing the datum of measurement for each traverse.

Three meters are mounted on the control desk; one shows the spindle h.p. and the other two indicate when coincidence has been achieved between the machine tool slide positions and the numbers set up on the desk. These are used principally for setting the datum for measurement but may also be used as a means of checking that correct positioning has been obtained. The accuracy required for the installation described here was $\pm 0{\cdot}0005$ in., but $\pm 0{\cdot}0002$ in. has been achieved in practice, and an accuracy of $\pm 0{\cdot}0001$ in. is possible.

To illustrate the time that can be saved by this machine, marking out, drilling and tapping a frame previously took 4 hours 34 minutes, but with the automatic setting equipment took only 2 hours 17 minutes.

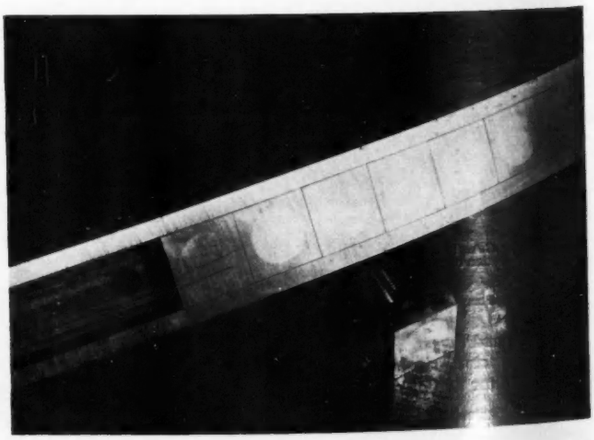


Fig. 4 Positions are determined by a measuring bar made up from 1 in. units exactly spaced. Small adjustments to the magnetic centres are possible to give an accuracy of $\pm 0{\cdot}000$ in.

In Parliament

UNIVERSITY RESEARCH

In a statement in the House of Commons last week, Mr. Henry Brooke, the Financial Secretary to the Treasury, said that the recurrent grants made by the Government to universities on the recommendation of the University Grants Committee were block grants given towards their maintenance as centres of advanced education and research. Part of these grants was spent on fundamental scientific research, but grants were not normally earmarked for specific purposes and, accordingly, research expenditure was not separately distinguishable. The provision for recurrent grants for the quinquennium from 1952 to 1957, as announced in February, 1952, had risen from £20 million for the 1952-53 financial year to £25 million for the 1956-57 financial year. Since that announcement, additional sums had been provided for increases in academic salaries and for the expansion of technology.

Mr. James Callaghan (Labour) asked if the Minister knew that the amount being spent on fundamental scientific research at the universities was estimated in some quarters to amount to about £5 million a year, and that there was a growing feeling that that sum was inadequate to the country's needs. He suggested that the universities should be asked how much was being spent by them for this very important purpose. Mr. Brooke replied that he was anxious not to embark upon a policy of these grants being earmarked by the Government for specific uses. It seemed far better to leave the matter to the discretion of the universities. As to the possibility of increasing the grants, the next quinquennium would be the right time to decide the amount of future payments.

TECHNICAL AID TO NEAR EAST

Countries belonging to the Bagdad Pact are to receive substantial technical assistance from Great Britain, according to a statement by Mr. A. D. Dodds-Parker, Joint Under-Secretary of State for Foreign Affairs. He said that the Economic Secretary to the Treasury, Sir Edward Boyle, Bt., had announced at the Tehran meeting of the Bagdad Pact Economic Committee that the British Government were willing to contribute £250,000, to be available over a period of five years, for technical assistance to approved projects designed to increase the economic well-being of these countries. The Government had also undertaken to contribute equipment and provide a Director and other staff for a proposed atomic training centre in Bagdad, and to give initial training in the United Kingdom for teachers for the centre, at an estimated total cost of £30,000 during the current financial year.

The Minister told Mr. Nigel Nicolson (Conservative) that, subject to obtaining parliamentary approval, the Government proposed to provide, for expenditure during the current financial year, the sum of £50,000 for technical assistance and a further sum of £30,000 for the atomic training centre. These amounts would accordingly be included in the Supplementary Estimates to be laid before Parliament in July.

RAIN-MAKING EXPERIMENTS

Recent experiments in producing rain in dry areas were brought to the attention of the House. These took place at Tabora, a railway junction and administrative centre in the Western Province of Tanganyika, which is dependent on the Kazima Dam for its water supply. Mr. Alan Lennox-Boyd, the Secretary of State for the Colonies, told Mr. James Johnson (Labour) that, owing to the partial failure of the seasonal rains, the level of the reservoir was dangerously low at the end of March and it was accordingly decided to carry out a "cloud-seeding" technique which had been evolved by the East African Meteorological Department in conjunction with the Admiralty and the Ministry of Supply. The experiments, which involved the use of 2 in. naval rockets, modified to incorporate particles of sea salt, were carried out between April 12 and May 2, and during that period 37 rockets were fired. Under the conditions prevailing, the best results were achieved when the rockets burst at about 3,000 ft. and about 1½ miles down wind of the catchment area of the Kazima Dam.

The results of these efforts were still being studied but there was definite evidence, Mr. Lennox-Boyd said, that, under suitable conditions, cloud-seeding did produce rain. A significant feature of the experiments was the repeated occurrence of rain over the catchment area about 12 minutes after seeding. At the conclusion of the experiments, the level of the reservoir was 2½ in. above the level at the beginning in spite of a daily consumption of 250,000 gals. and of high losses through evaporation. Rainfall recorded in the catchment area during April was about 1 in. to 1½ in. greater than that measured at stations near to but outside the catchment area.

STEEL FOR RURAL CRAFTSMEN

Shortages of steel supplies, especially in agricultural districts, have been engaging the attention of members. Mr. Marcus Kimball (Conservative) asked the President of the Board of Trade about the continuing lack of supplies of iron and mild steel for rural craftsmen, particularly in Lincolnshire, and Sir Frank Medlicott (National Liberal and Conservative) inquired whether the President was aware that there was still a noticeable shortage of iron and mild steel in sizes suitable for rural craftsmen. Sir Frank stated that this situation was causing delay in the repairing of agricultural machinery in East Anglia. In reply, Mr. Peter Thorneycroft said that the production of small sizes of iron and steel had been increased during the past six months. But it happened that rural craftsmen were using steel this year at the rate of 10 per cent. above that of last year and, in consequence, there might still be shortages in some rural districts. He understood that the Iron and Steel Board had been having discussions during recent weeks with representatives of the craftsmen concerned about the relief of their problems.

Employment on the Railways

Mr. S. S. Awbery (Labour) drew attention to the shortage of manpower in the South Western Region of British Railways, particularly among signalmen and firemen, and asked if the Minister of Labour and National Service would take steps to raise the calling-up age in railway employment by one year, in order to ease the situation. Mr. Awbery pointed out that action had been taken against the British Transport Commission recently for employing young men on night work, when it did so because other labour was not available. Mr. Iain Macleod replied that he was aware of the shortages of labour in the railway grades referred to and was carefully watching the position. Both the Commission and the National Union of Railwaymen had made representations to him on the subject, and had referred to the employment of young men on night work, but he had not so far replied. Among other considerations, it would probably need legislation to put this particular difficulty right.

Fixed Price Tenders

Mr. G. Nabarro (Conservative) referred to the policy of the Minister of Works of extending the range of fixed price tenders to his Department to tenders of up to a maximum value of £100,000, and asked the Minister what arrangements he proposed to make to permit price variations, or the insertion of "escalator" clauses to allow for possible increases in charges by the nationalised coal, gas, electricity and transport industries during the currency of such contracts, having regard to the fact that private contractors had no control over the charges of these industries. Mr. Patrick Buchan-Hepburn replied that he was not proposing to make any arrangements for price variation. The whole point of his experiment of seeking fixed price tenders for selected projects undertaken by his Department was to find contractors who were prepared to accept all the risks of fluctuations in costs. The scheme, which was at present limited in its extent, was a voluntary one and there was no compulsion on anyone to come forward on the terms suggested.

Salvage of Ferrous Scrap

Mr. J. Stuart, the Secretary of State for Scotland, informed Mr. R. S. Russell (Conservative) that statistics showing the amount of household refuse disposed of by local authorities in Scotland, without attempts being made to recover scrap metals, textiles, glass and paper, were not available. It was known, however, that valuable materials were being recovered by local authorities representing at least 70 per cent. of the population of Scotland. Circulars had been issued from time to time asking local authorities there to take steps to increase the salvage of iron and steel scrap and tins.

Dissemination of Research Information

In his capacity of representative of the Lord President of the Council, Mr. J. R. Bevins, Parliamentary Secretary to the Ministry of Works, stated that research associations in receipt of grants from the Department of Scientific and Industrial Research were advised to make information available as widely as possible without prejudicing the welfare of their own members or of the industries they served. Mr. Bevins emphasised that these organisations were autonomous bodies and that the Lord President was in no position to dictate to them. He agreed with Mr. K. P. Thompson (Conservative) that information from research associations should be widely circulated, but said that it was desirable that these bodies should stand more and more on their own feet financially. The supply of information was an incentive to membership, and, consequently, to financial support.

Simpler Automation Report Needed

A suggestion was made that the recent D.S.I.R. report on automation was too technical to be widely read by workpeople who feared unemployment in consequence of the introduction of this technique. Mr. Robert Carr, Parliamentary Secretary to the Ministry of Labour and National Service, told Mr. C. Osborne (Conservative) that it was certainly the intention of the Government to make information about automation as widely known as possible. He was informed that, with that end in view, the D.S.I.R. was preparing a simplified version of the recent report. Mr. Osborne pointed out that the existing report dealt with the technical aspects of the subject and not with the social side which was causing men to fear that they were going to lose their jobs because of automation. The existing report did nothing to satisfy the men and end their fears. Mr. Carr replied that he appreciated this point and thought it right that a shorter version of the report should be published. The implications of automation would presumably be considered by the Ministry's National Joint Advisory Council.

Inter-Union Disputes

Replying to Sir Frank Medlicott (National Liberal and Conservative), who asked what steps were being taken to end the dispute between two trade unions as to whose members should load coal-mine refuse at Blyth, Northumberland, Mr. Carr said that his Ministry was aware of the dispute and that negotiations were in progress between the parties. Sir Frank pointed out that, owing to the dispute, a new £50,000 conveyor belt system had been kept idle for seven weeks, and he suggested that these wasteful stoppages might be avoided by ensuring that the members of one particular union started the work pending any later decision through the demarcation machinery. Mr. Carr said that his Ministry was always ready to help when invited, but it was felt that negotiation within an industry was the best way of settling disputes of this kind. In the specific case referred to, such negotiations were, in fact, in progress.

THE HUMAN ELEMENT

Position and attitude of the T.U.C.—Trade unions and wage restraint—Can a labour force ever be cut?—Red herring of automation—Interchange between Forces and industry—Reduction in hours not merely humanitarian.

★ ★ ★

What is the T.U.C. Doing?

A few criticisms of the Government, a little well-meant public relations, news about forthcoming reports and a letter to the Minister of Labour about nurses seem to be the main *pièces de résistance* of the T.U.C.'s half yearly report. "What the T.U.C. is Doing" is unlikely to move the rank and file either to public-spirited sacrifice or to trade union fervour. The main attack on the Government is on its economic policy. Too little forethought, not enough planning: "there is no conscious direction of the nation's affairs." The words unhappy, misguided, unfair, relate to the "negative policy" of "reliance on rising prices to restrain personal spending." Slowly, ponderously, the T.U.C. horse is turning its back on the Government and getting into position to deliver its biggest post-war kick in the teeth.

Some of the more encouraging prose refers to the T.U.C.'s efforts to find facts about automation. Doubtless this will be a difficult and lengthy business, but "the forward-looking trade unionist," for whom the report was evidently written, "wants to be sure that the best use is made of machines and materials and of the skill and experience of workers." This is a tall order, and could be even for Mr. Gaitskell's bright boys at Transport House. There is a lack of down-to-earth realism about all these trade union statements.

The advance of the Left in trade union affairs, which has become marked in the past two years, can hardly be said to have resulted from unemployment—or from starvation wages. It has taken place in a period of unmatched prosperity. What would happen should the tide really turn, and full employment melt away, is anyone's guess. Few would doubt that it would be most unpleasant.

★ ★ ★

A Chilly Reception for the Chancellor

The "hold-wages-back" speech by the Chancellor of the Exchequer (Human Element, May 1) has produced more angry retorts than understanding nods. There is something about Mr. Macmillan that pleases not at all even the holiest right wingers in the trade union movement. Mr. Alan Birch, secretary of the Shop, Distributive and Allied Workers, referred to him as "rapidly earning the title of Mr. Face-both-ways" and expressed his union's dismay at the Government's failure to arrest the spiral of rising prices. Mr. Frank Cousins, the recently elected general secretary of the Transport and General Workers, said "we are not impressed by him telling us that if there are no wage increases for twelve months everything will be all right." In Mr. Cousins' view the Government are manoeuvering to create a situation in which the union's bargaining power is lowered, through the gradual abandonment of a full-employment policy. Mr. E. Hill of the Agricultural Workers joined in the attack with words which stressed the difficulties facing the unions who have been left behind in the race: "It comes ill from the Chancellor to suggest that agricultural workers should practise wage restraint. We have practised restraint for too long. With the result that we find outselves on the bottom rung of the wages ladder."

There were many other critics. It is by now crystal clear that appeals will achieve little, whether for price or wage restraint. Always there is someone who lags behind and wants to catch up. In any case any Minister who advocates wage restraint when there is more publicity concerning short-time working than over-time is inevitably suspect. What was said by Mr. Cousins about bargaining power must be in the minds of many.

★ ★ ★

Redundancy and Strike Action

The executive council of the A.E.U. suddenly, and somewhat surprisingly even to their own ranks, gave official recognition to a strike over redundancy at Norton's which began on April 30. Already they were paying strike pay but the union had been cautious over extending their full support. An immediate result was to extend the strike from the 274 workers dismissed three days previously to the 500 union members. The recognition came at a time when the strike was losing support, so much so that the strike committee were brought to the position of promising to try to get the management to give the men their jobs back.

The real significance of the move is two-fold. First it was timed on the day before the Standard Motor management were due to meet local union officials on the threatened redundancy of 2,640 workers at the company's tractor factory. The Norton strike began over the redundancy of a night shift of 26 workers. Second, the decision was taken at an A.E.U. executive meeting presided over by Mr. J. Scott, a member of the Communist party. The Standard strike committee will be encouraged, and so will the communists and their sympathisers. The Norton dispute could be a curtain raiser for something really big and nasty in the Midlands and in the A.E.U.

Such action by union leaders does raise this question: what does a firm do when it cannot keep up the sales of its goods? Apparently, keep all hands on deck and await the receiver. It is difficult indeed to predict what the attitude of the A.E.U. council will be over the terms offered by Standard to the 2,640 workers who are being laid off. All the union's proposals except short-time working have been rejected, on the grounds that they are unpracticable. Compensation of £15 on leaving was the farthest the management were willing to go. Notices were given last week to half the men involved. Now the ball is in the union's court.

★ ★ ★

The Standard Affair

When the Standard Motor Company suddenly announced (though signs were not lacking beforehand that something of the kind was coming) that 2,640 men would be laid off permanently at the new tractor plant while 1,200 of those affected would be taken on at the car plant, the issue was a new one so far as matters between the union and the management were concerned. It became one of permanent and not temporary redundancy. Given the market conditions of 1955, the redundant workers might well have been absorbed at the car unit and it was a major slice of misfortune for the company that the new tractor production was due to start at a time when the car market was still weak.

When the announcement was made, a flood of confused and dangerous reporting about the impact of automation was released in the national Press—until the headlines were captured by an even more sensational industrial story about mink. The reporting and comment on the Standard affair in certain quarters may yet prove a grave disservice to British industry. It has fed the flames of ignorance and suspicion when clarity and calmness were called for.

The situation at Standard's was to be considered at a meeting at York after this issue had gone to Press and, whatever may have been the outcome of it, there were signs beforehand that the unions concerned are approaching the matter with some caution. The immediate cry from Coventry for a strike has met with no official response as yet. It is not surprising. The unions are up against something of a brick wall, for it is difficult for them to argue that a company must continue to employ labour when turnover ceases to be buoyant. The Standard affair is better looked at from this angle than from that of automation. In any case, there are still plenty of vacant jobs in the Midlands.

★ ★ ★

Smaller Armies

A political atmosphere in which there is talk of the partial demobilisation of armies is bound to bring with it a feeling of reduced tension—which is all to the good. A combination of circumstances have brought this state of affairs about. Atomic war is, at least at first, a war of experts. Growing concentrations of men can no longer be equipped with equivalent growing concentrations of fire-power. Men become, up to a point, redundant. When political stalemate occurs at the same time it is not surprising that "hot" war and "cold" war alike are put aside at least temporarily for economic penetration. This means building up industrial potential and the men are needed, marginally anyway, less with guns than with ploughs and spanners. It is these broad facts which lie behind the cut in the Soviet armed forces and the reduction in those of the United States—although the Russians with characteristic shrewdness have snatched the initiative in the matter.

Nearer home, the recent improvement in Service pay has helped recruitment, and the goal of a fully professional army seems less remote. Conscription is now more or less doomed because the conditions for its abolition, set out in the White Paper issued last January, show signs of being broadly fulfilled. If the idea of a technical regular army is in fact achieved, one of the considerations which should be constantly examined is the use of highly qualified men by the Services and the improvement of the means whereby men of technical experience can be reabsorbed into civilian life while still comparatively young and active.

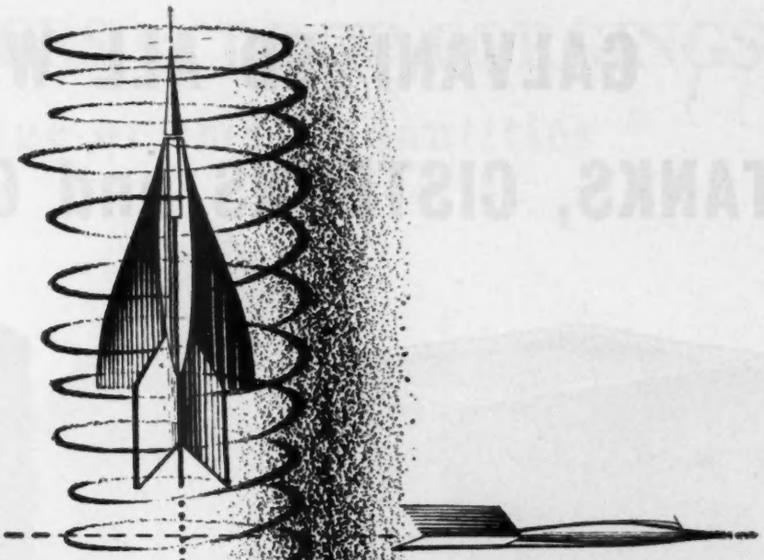
★ ★ ★

Young Russians' Working Hours

The Russians know—none better—how to make a propaganda advantage out of a situation. Last week Moscow radio announced that the working day for youngsters between 16 and 18 had been reduced to six hours by Government decree. Pay will remain the same as when they worked an eight-hour day. This fits in well with the new era of enlightenment.

What it means in practice is exceedingly difficult to say. The background is one of an acute shortage of labour which is causing a switch of manpower from the armed forces to agriculture and industry. There is also a shortage of trained technicians, although impressive figures have been released of late about the Russian performance in this direction. In contrast with this background of shortage, there have been reports in recent months of gross overworking of operatives in some areas, which have been reflected in the health figures of adolescents. Sickness and arrested physical growth have been increasing.

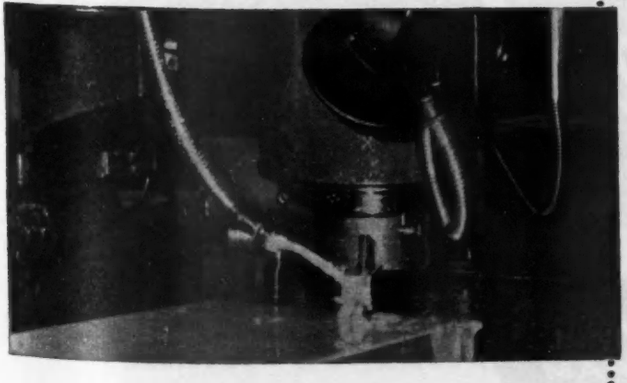
One thing is almost certain. Whatever impression of humanitarianism the announcement was expected to give, the fact of the change in hours is part of a complicated problem of the supply and demand for labour. It is the sort of statement which does not mean only what it says. The Soviet system will not reduce working conditions for youngsters at a time when all the emphasis is on a demand for bigger effort from labour as a whole, unless it is to be compulsorily trained for more skilled work or the time has come for political reasons to relax the screws in order to tighten them up later on.



the way the wind blows—

—at the AIRCRAFT RESEARCH ASSOCIATION LIMITED

The way the wind blows in the wind tunnels of the Aircraft Research Association at Bedford reveals valuable data which points the way to future design—of both complete aircraft or sections of aircraft. The models tested at these advanced laboratories, averaging 3 feet semi-span dimensions, must conform to ultra-operational standards, placing great responsibility on men, machines and materials. Throughout this works, Wakefield-Dick production oils and lubricants are found—giving the same high service to the Aircraft Research Association technicians that the aircraft and engineering industries have experienced for very many years.



INDUSTRIAL WAKEFIELD-DICK LUBRICANTS

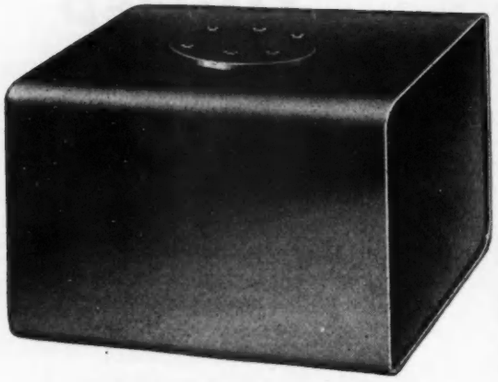
WAKEFIELD-DICK INDUSTRIAL OILS LTD

67 GROSVENOR STREET, LONDON, W.1

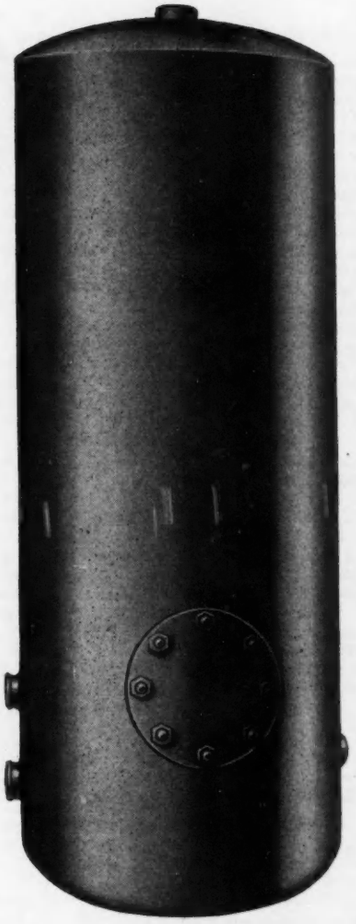
MEMBER OF THE WAKEFIELD CASTROL GROUP OF COMPANIES

GALVANIZED ALL WELDED TANKS, CISTERNS and CYLINDERS

Cold water cisterns to suit all Water Authority requirements.



Hot water tanks in all sizes and capacities.



All welded vertical hot water cylinders, indirect cylinders and calorifiers.

MANUFACTURED IN ALL SIZES STANDARD, SPECIAL OR TO B.S. SPECIFICATION EXPORT ENQUIRIES INVITED.

CATALOGUES AVAILABLE ON APPLICATION.

Jenkins of ROTHERHAM

FERHAM BRAND

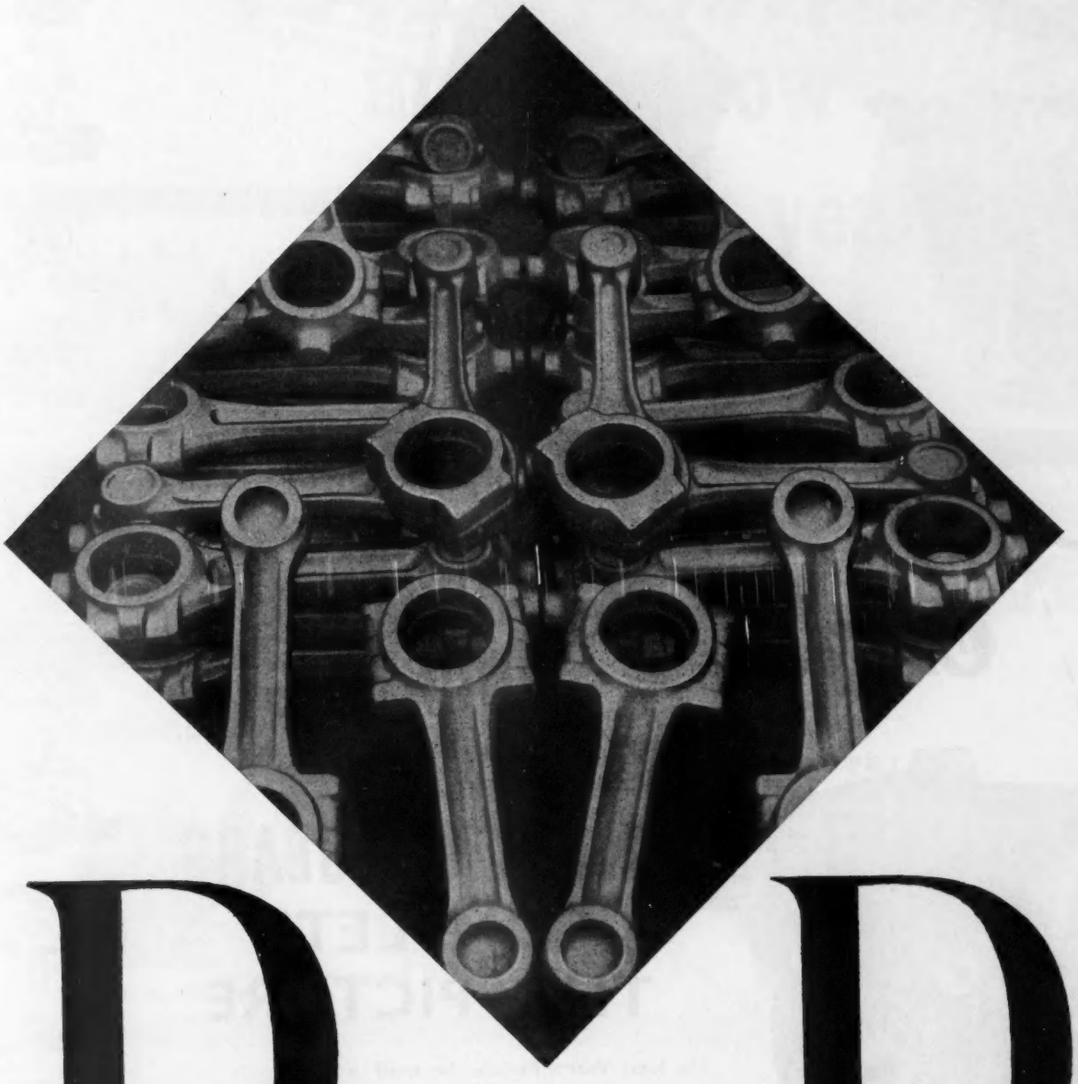
THE SIGN OF GOOD WELDING

Robert Jenkins & Co. Ltd.
ESTABLISHED 1856
ROTHERHAM

Tel: 4201-6 (6 *lines*)

DONCASTERS for DROP FORGINGS

in large or small quantities



D D

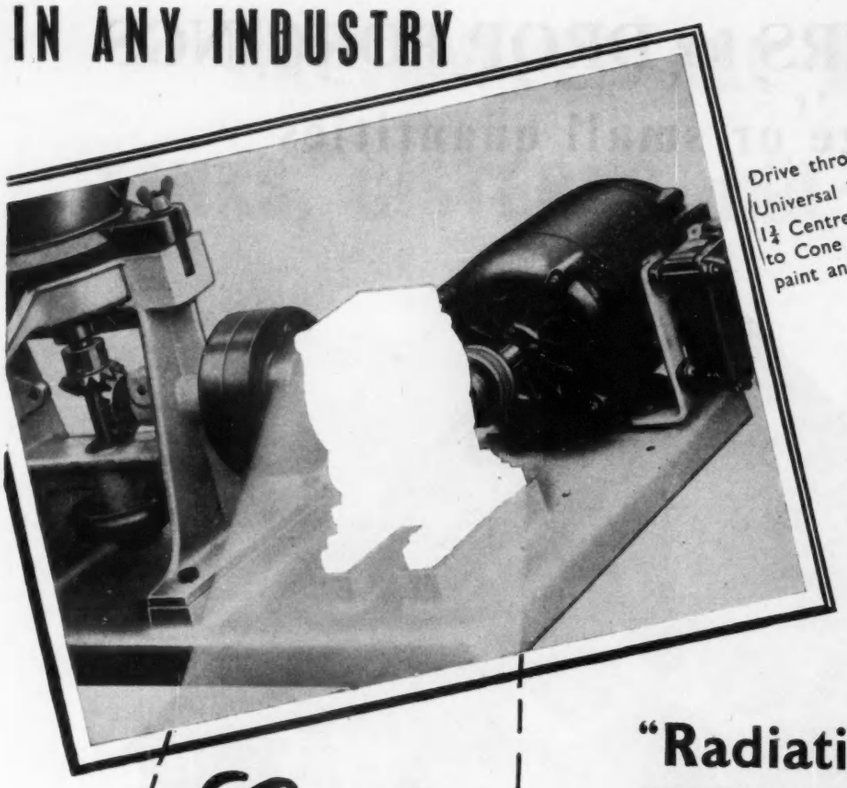
DONCASTERS 1778 D D

DANIEL DONCASTER & SONS LIMITED · SHEFFIELD

FORGINGS · DROP FORGINGS · HARDENED STEEL ROLLS · HEAT TREATMENT

F. 36

IN ANY INDUSTRY



Drive through Crofts Universal Mounting Worm Gear, 1¾ Centres and Flexible Coupling, to Cone Grinding Mill for paint and ink trade.

ALTERNATIVE FOOT MOUNTING POSITIONS

Crofts

"Radiation" UNIVERSAL MOUNTING WORM REDUCTION GEARS COMPLETE THE PICTURE

The ideal Worm Reducer for small power applications up to 2½ H.P. Ratios 5 - 1 up to 60 - 1. Standard, Vertical & Inverted units FROM STOCK. Adaptable for every possible mounting position.

For details see Pub. No. 532/11 Fill in, or attach letterhead, and post for your copy NOW!

NAME . . . . . .

ADDRESS . . . . . .

. . . . . .

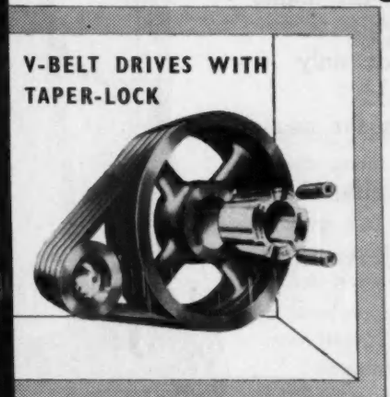
Crofts (ENGINEERS) LIMITED. BRADFORD 3. ENGLAND

182

PHONE 65251 (15 LINES) 'GRAMS "CROFTERS BRADFORD"

AT THE MACHINE TOOL EXHIBITION

and on show all the year round



by FENNER OF HULL

IN ATTENDANCE ON STAND 638B, NATIONAL HALL, OLYMPIA

I. A. F. MACNAIR (*London Regional Manager*) June 22, 23, 27, 28, July 2, 3.

C. S. HANDLEY (*Assistant London Regional Manager*) June 22, 23, 25, 26, 29, 30, July 4, 5, 6.

G. K. VARLEY (*Sheffield Branch Manager*) . . . . . June 25th to 29th.

F. GRINDLAY (*Leeds Branch Manager*) . . . . . July 2nd to 6th

AT THESE FENNER BRANCHES

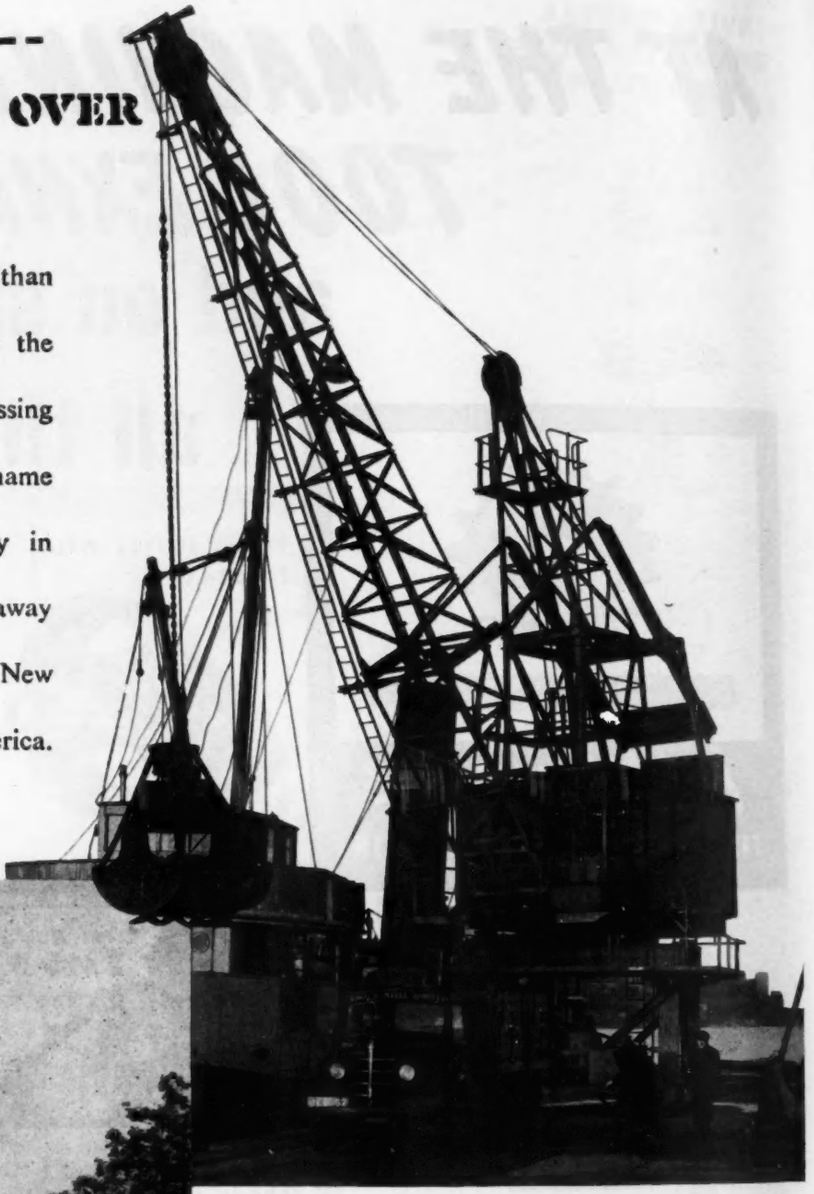
BELFAST, 35 King Street ..... *Belfast* 25409
BIRMINGHAM. V-Belt House, 25 Broad Street, 1 *MIDland* 4505/6
BURNLEY, V-Belt House, 73/77 Manchester Road *Burnley* 2258
CARDIFF, V-Belt House, West Wharf Road *Cardiff* 25151/2
CLECKHEATON, 92 Whitcliffe Road *Cleckheaton* 891/2
GLASGOW, 98 Holm Street, C.2 .....*City* 7136/7
HULL, Marfleet Avenue .....*Central* 13900
LEEDS. 32 Dewsbury Road, 11.....*Leeds* 33420
LEICESTER. V-Belt House, 50 Southgate Street *Granby* 223
LIVERPOOL. V-Belt House, 42 Great Howard Street .....*Central* 3236
LONDON. V-Belt House, 54 Southwark Bridge Road, S.E.1.....*Waterloo* 7466/7
LUTON. V-Belt House, 58 Bute Street and 38 Guildford Street ..... *Luton* 5089
MANCHESTER. V-Belt House, 454 Chester Road .....*TRAfford Park* 1341
NEWCASTLE-ON-TYNE, 61 Westgate Road *Newcastle* 24684
NOTTINGHAM. V-Belt House, 136 Canal Street *Nottingham* 41079
SHEFFIELD. V-Belt House, 86 Bridge Street *Sheffield* 27774
STOCKTON-ON-TEES. V-Belt House, 18 William Street.....*Stockton-on-Tees* 68064
STOKE-ON-TRENT, V-Belt House, 32 Hartshill Road .....*Stoke-on-Trent* 44587

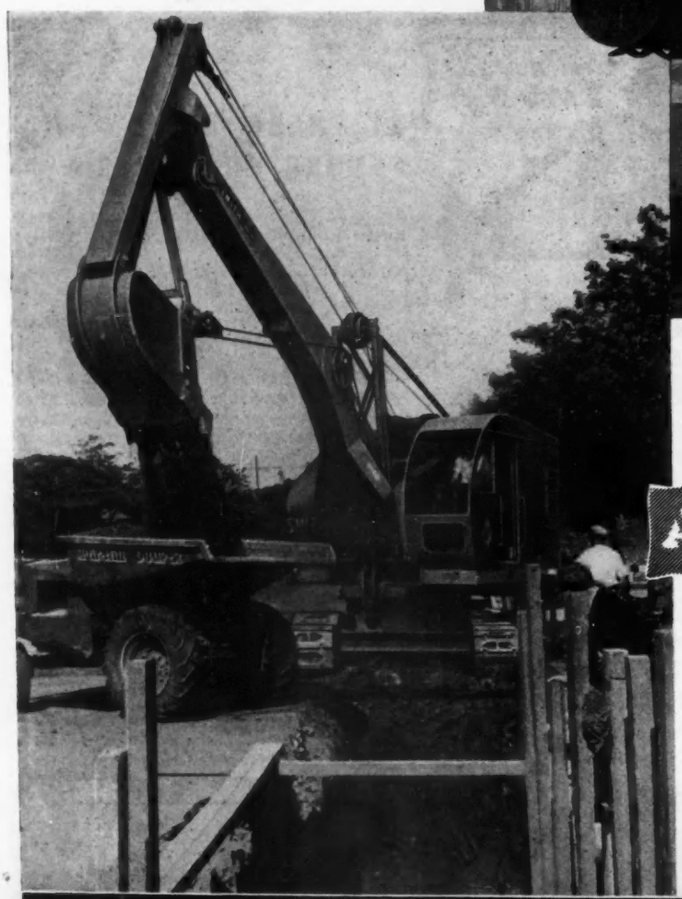
J. H. FENNER & CO. LTD · HULL

LARGEST MAKERS OF V-BELT DRIVES IN THE COMMONWEALTH

MADE IN RODLEY -- IN ACTION ALL OVER THE WORLD!

Yorkshire can provide more than its quota of famous names in the engineering field. When discussing Cranes and Excavators, the name Smith is outstanding, not only in Britain but in regions as far away as Burma, India, Australia, New Zealand, Canada and South America.





SMITH CRANES AND EXCAVATORS

Smith machines include steam locomotive and railway breakdown cranes; diesel locomotive and mobile cranes; electric locomotive, dockside and gantry cranes; truck-mounted mobile cranes; universal excavators from ⅜ to ¾ yd. bucket capacity.

THOMAS SMITH & SONS (RODLEY) LTD. · RODLEY · LEEDS · ENGLAND

GENERAL DESCALING FREES BLOCKED SEWERS

after Tip Blaze in Huddersfield

Photos by "The Huddersfield Examiner"

*GENERAL DESCALING M.C.E.**
*(*Mechanical and Chemical Engineer)*

Scene of General Descaling's operations at Huddersfield.

NEW ROLE FOR VETERAN OF SCALE WARS

Assault Detachment, Huddersfield, Friday. *Shock troops under General Descaling, veteran campaigner of anti-scale warfare have been actively engaged in ridding two Huddersfield sewers of the General's old enemy, chemical wastes.*

When flames reached highly inflammable materials in a local tip blaze, burning lava-like material flowed into nearby sewers where it hardened to cause a complete blockage.

Urgent appeal for relief was sent to General Descaling at his Headquarters in Worksop. Accompanied by highly trained forces with the latest equipment, he was soon at the front and had launched a counter-offensive to clean up the blocked 12in. and 27in. piping. The attack was a complete success and the sewers were freed for a fraction of the cost of replacement—the only alternative.

"WE ATTACK ANY KIND OF STOPPAGE"

Jobs like this which give Drainage Authorities real headaches make the General smile in anticipation of a fight he knows he will win. The harder it is, the more he likes it.

Forces are also available to descale gas and water mains at a fraction of their cost of replacement. Even the toughest deposits are eliminated with speed and safety, leaving a finish as good as new. There's a minimum of cutting and disturbance of services; and no damage to pipes and ferrules.

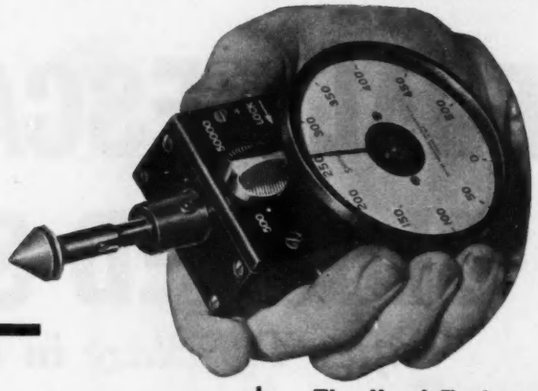
Any size of pipe in any material or of any construction can be attacked, whilst bitumen relining is available to consolidate the position after scale has been routed.

Send for details of the General's services—today!

GENERAL DESCALING CO. LTD. H.Q. WORKSOP NOTTS. TEL 3211-3

OA 3210

That most versatile Instrument — *the Hand Tachometer*

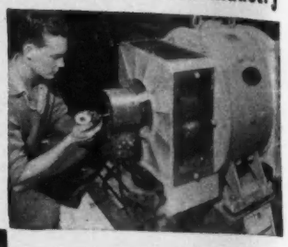


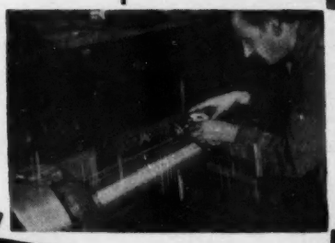
The SMITHS Hand Tachometer is used by such a wide variety of industries and trades and for so many different purposes, that to mention a few applications is but scratching the surface. Its users range from major industries to small workshops and include manufacturers of hair nets, toffee, umbrellas, slippers and—quite likely, candlestickmakers.

Briefly, Smiths Hand Tachometers provide a ready and accurate check on rotational and surface speeds. Their use is a safeguard against excessive wear of plant and uneconomical operation.

The Hand Tachometer serves Industry

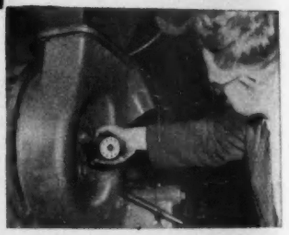
A Hand Tachometer is shown here at a G.E.C. factory, measuring rotational speed during the normal testing of a 10 kW, 125 volt exciter.





In this instance, the English Steel Corporation Ltd. are using a Hand Tachometer to indicate the surface speed of a test bar during a turning tool investigation.

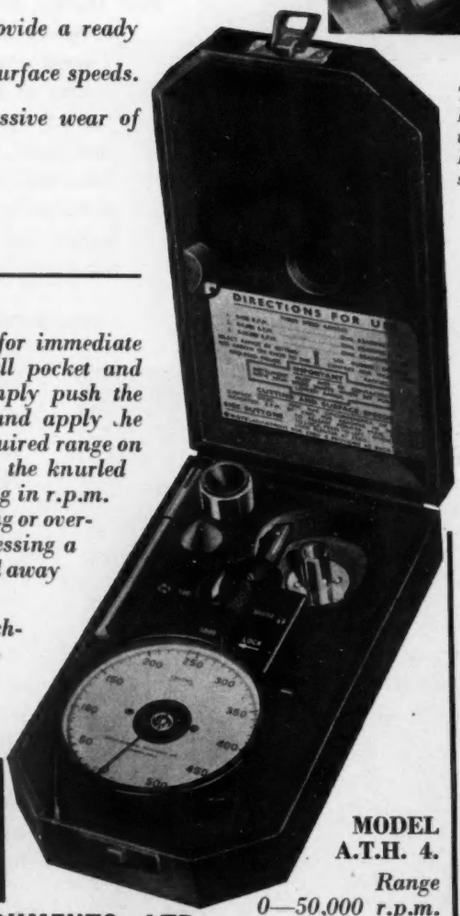
This picture shows a Hand Tachometer in use by 'English Electric' for rating superchargers.



Using the Hand Tachometer

The instrument is always ready for immediate use. It can be slipped into an overall pocket and carried as easily as a slide-rule. Simply push the appropriate attachment on to spindle and apply the instrument to the belt or shaft. The required range on each Tachometer is selected by turning the knurled knob and the dial gives the correct reading in r.p.m. or f.p.m. Under conditions of bad lighting or overhang, the pointer can be locked by depressing a button. The reading can then be observed away from the take-off point.

EACH SET COMPRISES Hand Tachometer, male rubber centre, female rubber centre, three-inch extension piece, disc for surface and cutting speeds (for reading in either feet or metres)



MODEL A.T.H. 4.
Range 0—50,000 r.p.m.

This versatile instrument is also used for

retiming diesels • press work • checking cutting speeds (especially during piece-working) • belt speeds • time and motion study • and for a thousand other purposes.

* *Accuracy ½% of the measured reading*
* *For either direction of rotation*
* *Will accept 100% overload*

MODEL A.T.H. 6.
Range 0—10,000 r.p.m.

MODEL A.T.H.7.
Range 0—20,000 r.p.m.

MODEL A.T.H. 10.
Range 0—5,000 r.p.m.

SMITHS

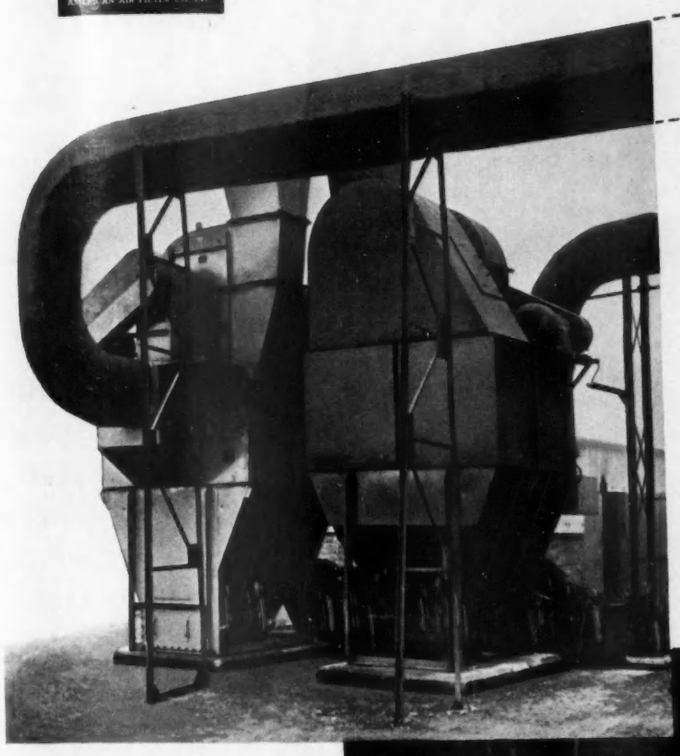
SMITHS INDUSTRIAL INSTRUMENTS LTD.

Chronos Works, North Circular Road, London, N.W.2. Telephone: GLAdstone 1136
Northern Sales Office: York House, 12 York Street, Manchester.
The Industrial Instrument Division of S. Smith & Sons (England) Ltd.

Send now for leaflet No. FY.596 giving full details of the 4 models available covering 0-50,000 r.p.m.

AP 188-311

AIR CONTROL IN INDUSTRY



LLOYDS (BURTON) LIMITED,

one of the best-known names in iron and steel, is yet another firm that is tackling its dust control problems with the help of Air Control Installations Ltd.

Up to now five Rotoclones have been installed with a total capacity of 65,000 c.f.m., cleaning up sand-handling, shakeouts and fettling.

We specialise in the manufacture of equipment for every form of air treatment and in harnessing air to work for industry.

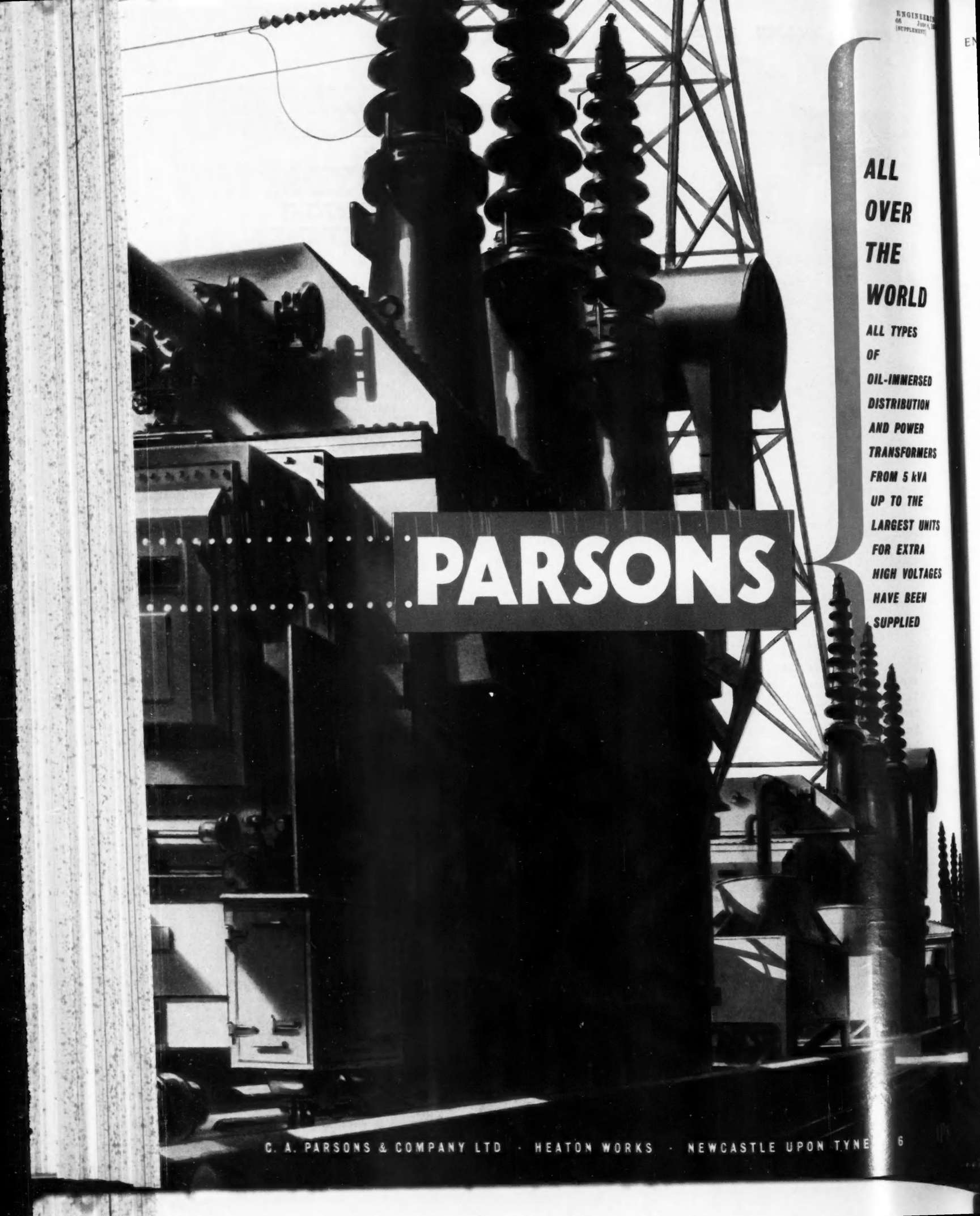
Consult our nearest branch.

AIR CONTROL INSTALLATIONS LTD.

RUISLIP · MIDDLESEX · RUISLIP 4066

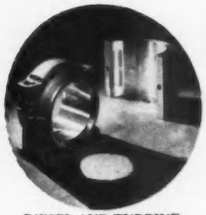
LONDON	BIRMINGHAM	MANCHESTER	NEWCASTLE	GLASGOW
Welbeck 1306 & 1307	Midland 1165 & 1367	Central 0679 & 0670	Whitley Bay 23046	Central 3923

ROTOCLONE – The plant that makes your works "NOT SO DUSTY"


PARSONS
ALL OVER THE WORLD
ALL TYPES OF OIL-IMMERSED DISTRIBUTION AND POWER TRANSFORMERS FROM 5 kVA UP TO THE LARGEST UNITS FOR EXTRA HIGH VOLTAGES HAVE BEEN SUPPLIED
C. A. PARSONS & COMPANY LTD · HEATON WORKS · NEWCASTLE UPON TYNE 6

GLACIER
Bearings and Bushes

TECHNICAL ADVISORY SERVICE


DIESEL AND TURBINE BEARINGS

SERVICE DIVISION

STANDARD BUSHES

BRONZE BARS AND WHITE METAL

Heavy Bearings

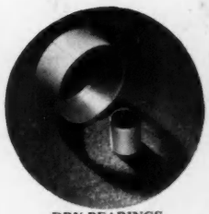
Glacier produce heavy plain bearings in the region of 6 inches bore and upwards for many well-known manufacturers of marine and stationary diesels, compressors, pumps, steam and gas turbines, rolling mills, crushers and other types of heavy plant and machinery.

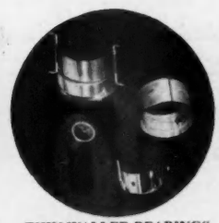
These bearings can be supplied complete and ready for assembly as steel or bronze shells lined with whitemetal or copper lead; or if preferred, customers' shells in the form of pressings, castings, forgings or stampings can be lined and delivered partly or fully machined.

Continuous development work over the years on production methods has resulted in the design and manufacture in the Company of highly specialised machine tools on which these large bearings are finished to extremely fine limits. For example bearing bores can, where necessary, be machined to give a wall thickness accuracy of $\begin{matrix}+\cdot00025''\\-\cdot00025''\end{matrix}$ i.e. a tolerance of ·0005″. Such accuracy has made it possible for builders of large diesel engines to reduce the fitting time on each engine from two days to a few hours.

Many leading firms consult the Company's Technical Advisory Department on the design and specification of bearings. This Department's team of engineers and metallurgists will provide without obligation proposals based on the best features of current practice leading to entirely new designs including thin walled bearings, or modifications to existing types to improve their performance. Since Glacier supply all types of plain bearings their design proposals are not influenced by manufacturing limitations.

CENTRIFUGAL FILTERS


DRY BEARINGS

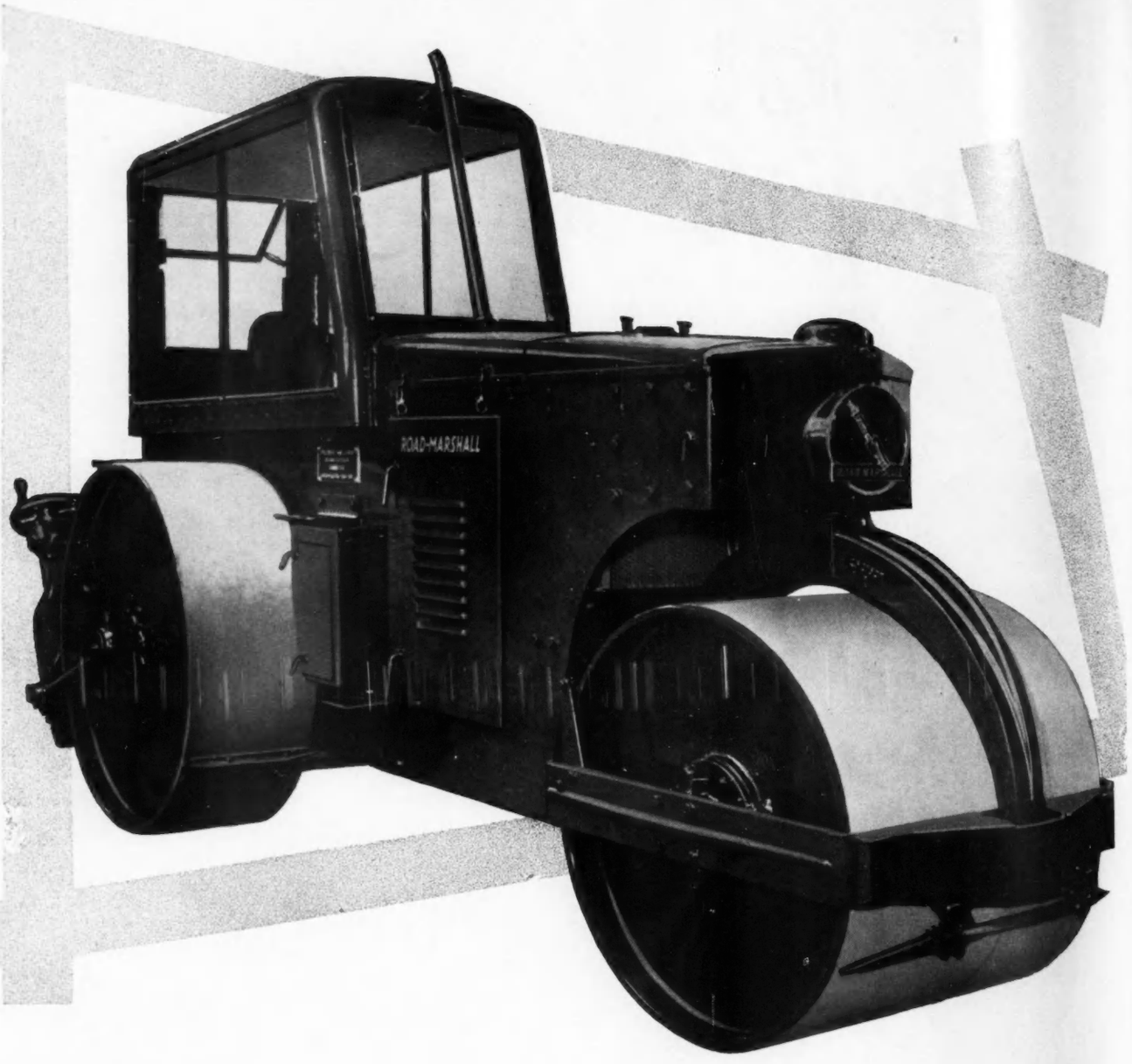

THIN WALLED BEARINGS

DIE CASTINGS

THICK WALLED BEARINGS

The largest manufacturers of plain bearings in Europe

THE GLACIER METAL COMPANY LIMITED, ALPERTON, WEMBLEY, MIDDLESEX



The New "Six-Eight" Road-Marshall

The ROAD-MARSHALL Series "SIX-EIGHT" is a new medium weight Roller which has been produced in response to repeated enquiries from our customers. We know that many users of the heavier ROAD-MARSHALL Diesel Rollers wished to have a medium weight Marshall roller as well, but up to now this has not been available.

There are two sizes giving weights 6-9 tons and 7-10 tons. The usual wide range of extra equipment can be fitted to suit Customers' specifications.

Road-Marshall Tandems are available in three sizes
35-50 cwt.

6-8 tons and 7-9 tons

Road-Marshall Three-wheel from 6 tons

to 15 tons

Write for literature to :

Marshall Sons & Co. Ltd.

GAINSBOROUGH, LINCS.
Telephone: Gainsborough 2301

any liquid any tank anywhere

Benzene, Benedictine or plain draught bitter —it doesn't make a drop of difference.

A Simmonds Contents Gauge tells you quickly and accurately the head, weight or volume of *any* liquid. The indicator may be on the tank or hundreds of feet away.

The readings of several tanks may be given on a single dial. Whatever the conditions the measurement is always accurate.

High or low level warning devices and flameproof hydraulic gauges are also available—and Simmonds engineers will give you all the advice you need.

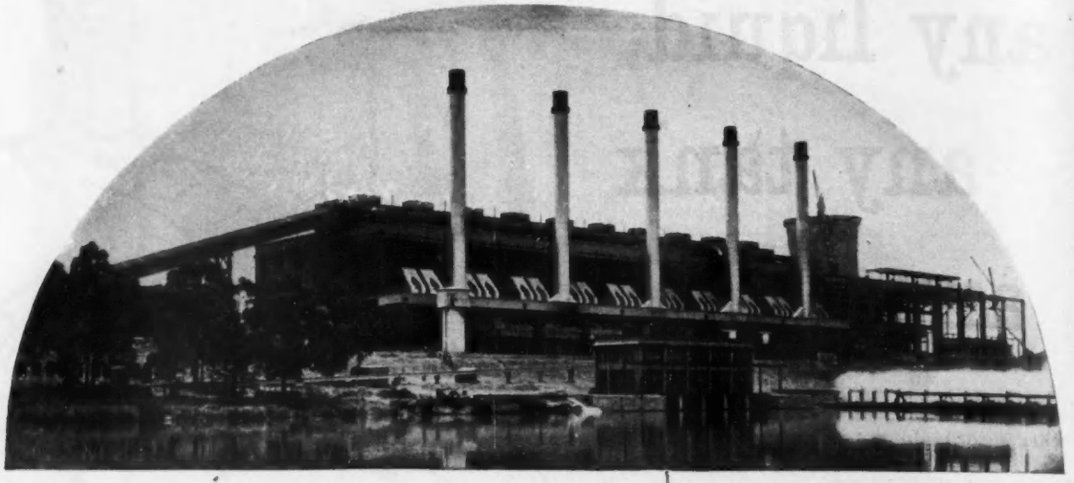
SIMMONDS CONTENTS GAUGES give the right answer

Manufactured by: **SIMMONDS AEROCESSORIES LIMITED** *Enquiries:* Byron House, 7-8-9 St. James's Street, London, S.W.1

Head Office & Works: TREFOREST, PONTYPRIDD, GLAMORGAN.

A MEMBER OF THE FIRTH CLEVELAND GROUP

CRC 199

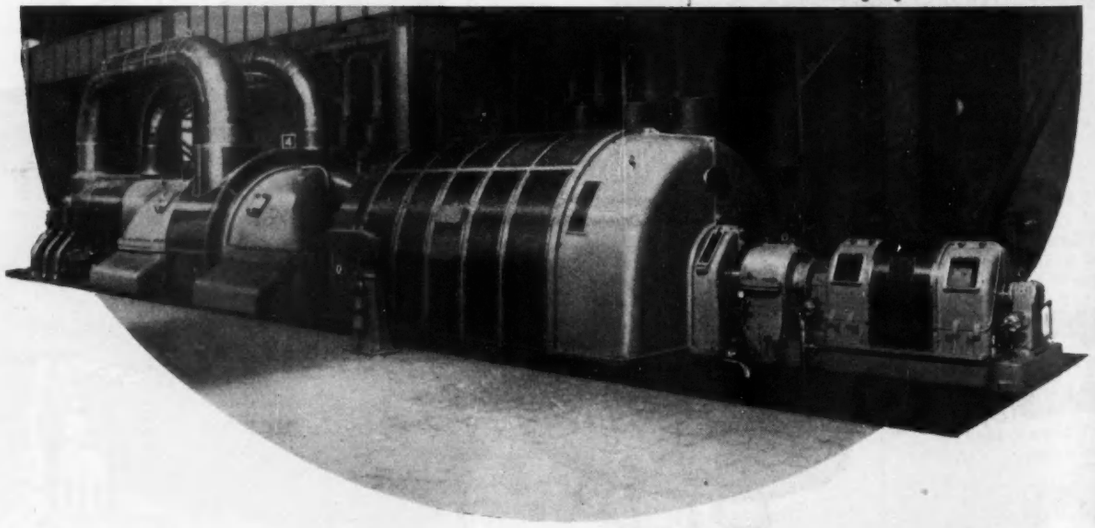


G.E.C.

TURBO-ALTERNATORS AT JOHANNESBURG

A 37.5 MW, 11 kV G.E.C. turbo-alternator in the Orlando Power Station, where five sets of this rating are in service. A further five 30 MW sets are being built.

Consulting Engineers : Merz & McLellan.



THE GENERAL ELECTRIC CO LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

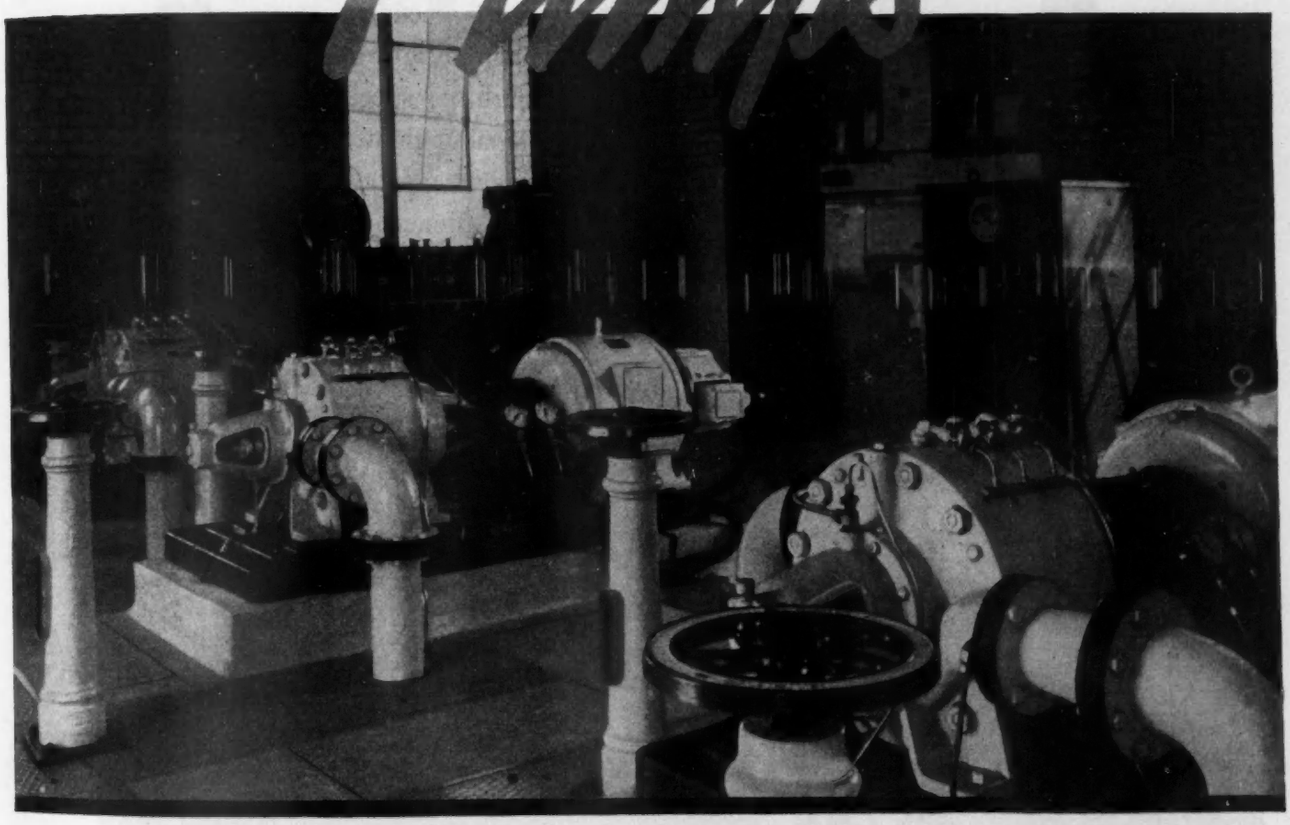
WEST DRAYTON · MIDDLESEX · ENGLAND

Telephone : West Drayton 2626 (4 lines)

Telegrams : Roc. West Drayton

VSESOJUZNOJE OBJEDINENIE
'MACHINOEXPORT'
EXPORTS:
Machinery and Equipment for Mining, Oil, Metallurgical and Electrical Industries, Power Plants, Pumping and Compressor Installations, Hoisting and Transporting Units, Chemical Equipment and Equipment for Light Industries
ALL TYPES ARE PROVIDED WITH SPARE PARTS
Maquinaria y equipos para las industrias minera, del petróleo, metalúrgica y eléctrica. Plantas de energía eléctrica. Instalaciones de bombeo y de compresores de aire. Unidades de elevación y transporte. Equipos químicos y Equipos para las industrias ligeras. Piezas de repuesto para todos los equipos.
Please address all enquiries in connection with purchasing equipment to:
V/O 'MACHINOEXPORT'
SMOLENSKAYA-SENNAYA PL. 32/34, MOSCOW G-200
Cable address: MACHINOEXPORT Moscow
VSESOJUZNOJE OBJEDINENIJE
MACHINOEXPORT

Gwynnes Pumps



The pumping machinery in the above photograph was supplied by Gwynnes Pumps Ltd to the instruction of Horace Rippin, Esq., A.M.I.C.E., A.M.I.Mech.E., A.M.I.W.E., Engineer and Manager to the East Elloe Rural District Council. The plant comprises two electrically operated automatic booster pumps and also one diesel engine driven booster pump. Each pump delivers 417 G.P.M. against a head of 200 ft.

GWYNNES PUMPS

GWYNNES PUMPS LTD

HAMMERSMITH LONDON W 6

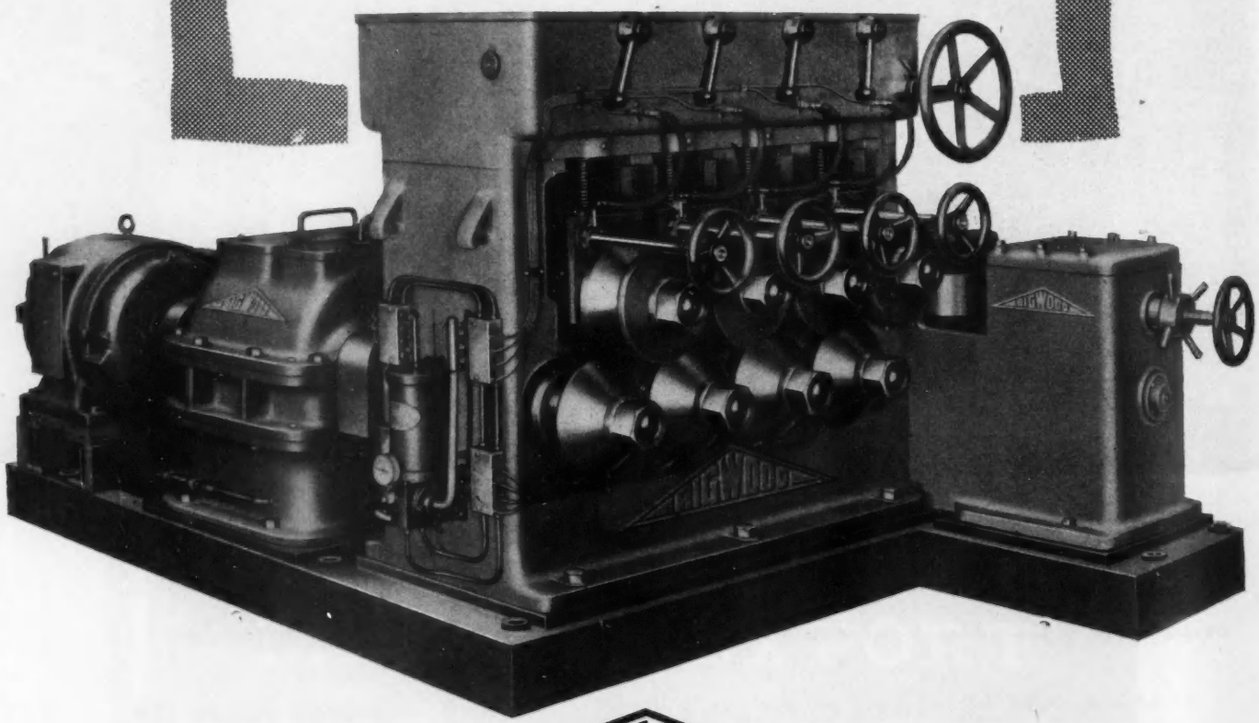
TELEPHONE: RIVERSIDE 3602 (4 LINES)

TELEGRAMS: GWYNNE HAMMER LONDON

WORKS at LINCOLN

SECTION STRAIGHTENERS

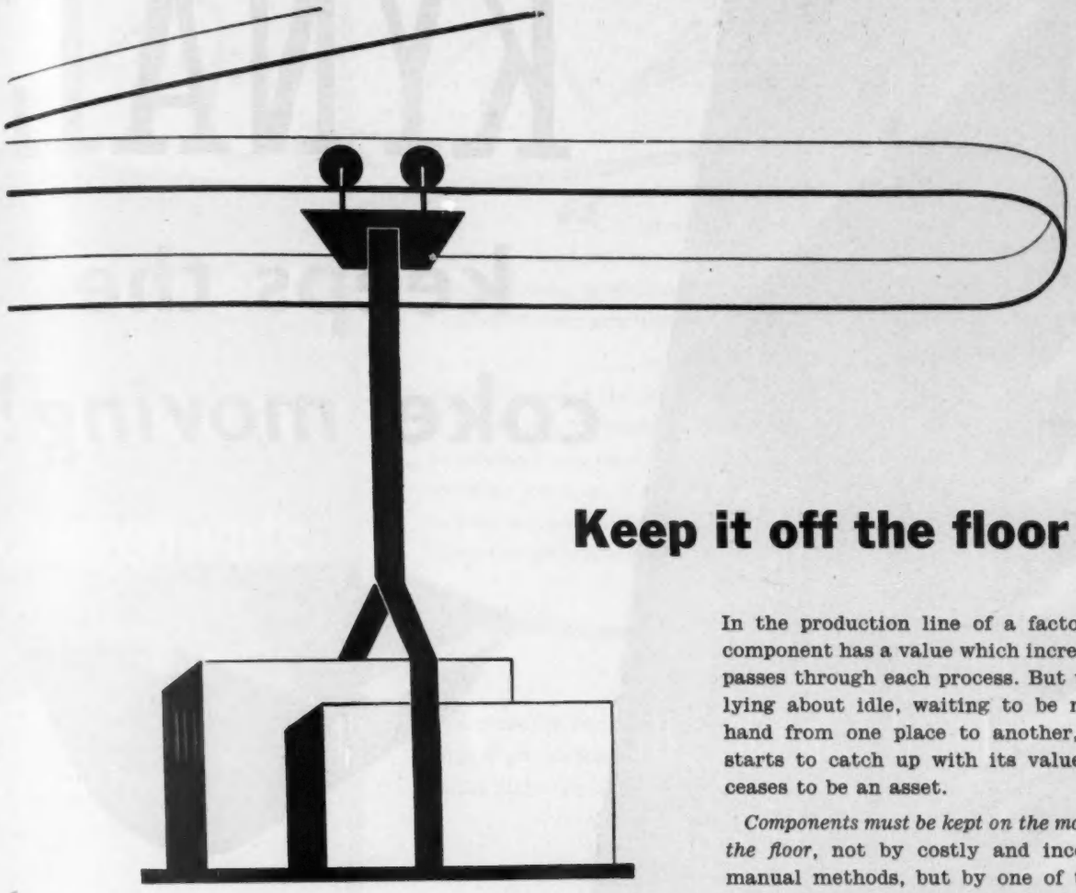
Section Straighteners—built in 10 sizes, with or without pinch rolls for high speed straightening of structural steel sections, rolled, extruded and drawn bar from light to heaviest sections. Single or multiple speed drive. Powered adjustment optional on lighter sizes, fitted as standard on heavier machines. A similar range of two-way straighteners is available for difficult work.



BIGWOOD

JOSHUA BIGWOOD & SON LIMITED · WOLVERHAMPTON · ENGLAND

B 129



Keep it off the floor!

In the production line of a factory every component has a value which increases as it passes through each process. But while it's lying about idle, waiting to be moved by hand from one place to another, its cost starts to catch up with its value until it ceases to be an asset.

Components must be kept on the move and off the floor, not by costly and inconvenient manual methods, but by one of the many types of mechanical handling equipment that occupy little or no floor space and can move parts horizontally or vertically to any part of the shop.

It's a fact that mechanical handling can do more for production than any other factory technique. This is only one of the many ways in which Electricity is playing a vital part in the drive for greater productivity.

Electricity for Productivity

Ask your ELECTRICITY BOARD for advice and information, or get in touch with E.D.A. They can lend you, without charge, films about the uses of electricity in industry. E.D.A. are also publishing a series of books on Electricity and Productivity. Titles now available are: Electric Motors and Controls, Higher Production, Lighting in Industry, Materials Handling, and Resistance Heating. Price 8/6, or 9/- post free.

Issued by the
British Electrical Development Association
2 Savoy Hill, London, W.C.2

'KYNAL'

keeps the coke *moving!*

Coal, coke and ashes are by no means easy to handle. Dry, their abrasive tendencies mean heavy wear and tear on containers. Wet, they create corrosion problems varying in degree from mild to severe. 'KYNAL' aluminium alloys are helping to solve both these difficulties. Coke elevator buckets made from 'KYNAL' M39/2 alloy—used by the Alliance and Dublin Consumers Gas Company since 1948—have a service life three times that of buckets in more conventional materials. These 'KYNAL' buckets have other advantages, too. Light as well as durable, they reduce the load on driving chains and sprockets and make possible notable savings in power and labour costs.

ICI

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

Current Beecham Achievements

"... let us say how very much we appreciate the fact you have completed our New Metal Finishing Department by the scheduled date, in spite of the appalling weather conditions which confronted your erection gangs last winter.

... the finished structure is light and airy, and has removed the terrible bogy of corrosion which has worried us for years. Throughout the whole of our factory the fumes from the Anodising Plant have adversely affected the steelworks—necessitating constant painting. Now, thanks to you, we have installed the plant in a corrosion-proof building, which requires no painting or maintenance and our Directors feel that we are very greatly indebted to you for your assistance."

The extracts quoted are from a letter written by a Director of Messrs. Haynes, Ford & Elliott Ltd.

... completed to schedule this factory illustrates another successful Beecham contract, undertaken during a period of maximum production.

Concurrently Beecham Buildings have erected the largest prefabricated industrial building in this country; a 200,000 sq. ft. factory in the Midlands. Their *new ways of building* allow Beecham to keep the pace on all their numerous contracts. For technical efficiency and well studied economy in Industrial Building you are advised to consult Beecham Buildings Limited.

May we advise you on your Industrial Building programme?

BEECHAM BUILDINGS LIMITED

DEPARTMENT G

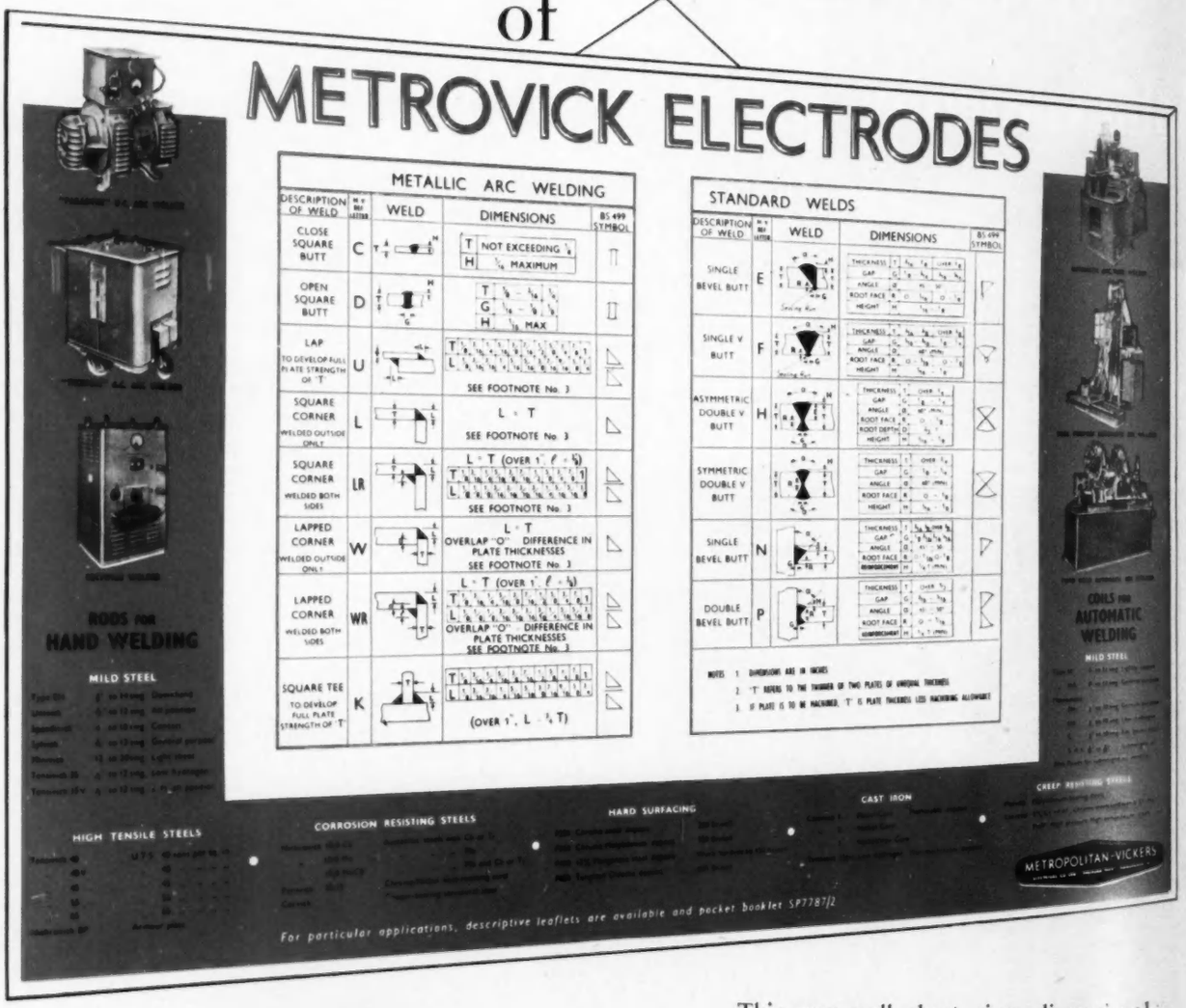
SHIPSTON-ON-STOUR, WARWICKSHIRE. Telephone: Shipston-on-Stour 315, 316 & 3287.

Beecham Buildings

AP.211.A4

Now Available!

New Wall Chart of METROVICK ELECTRODES



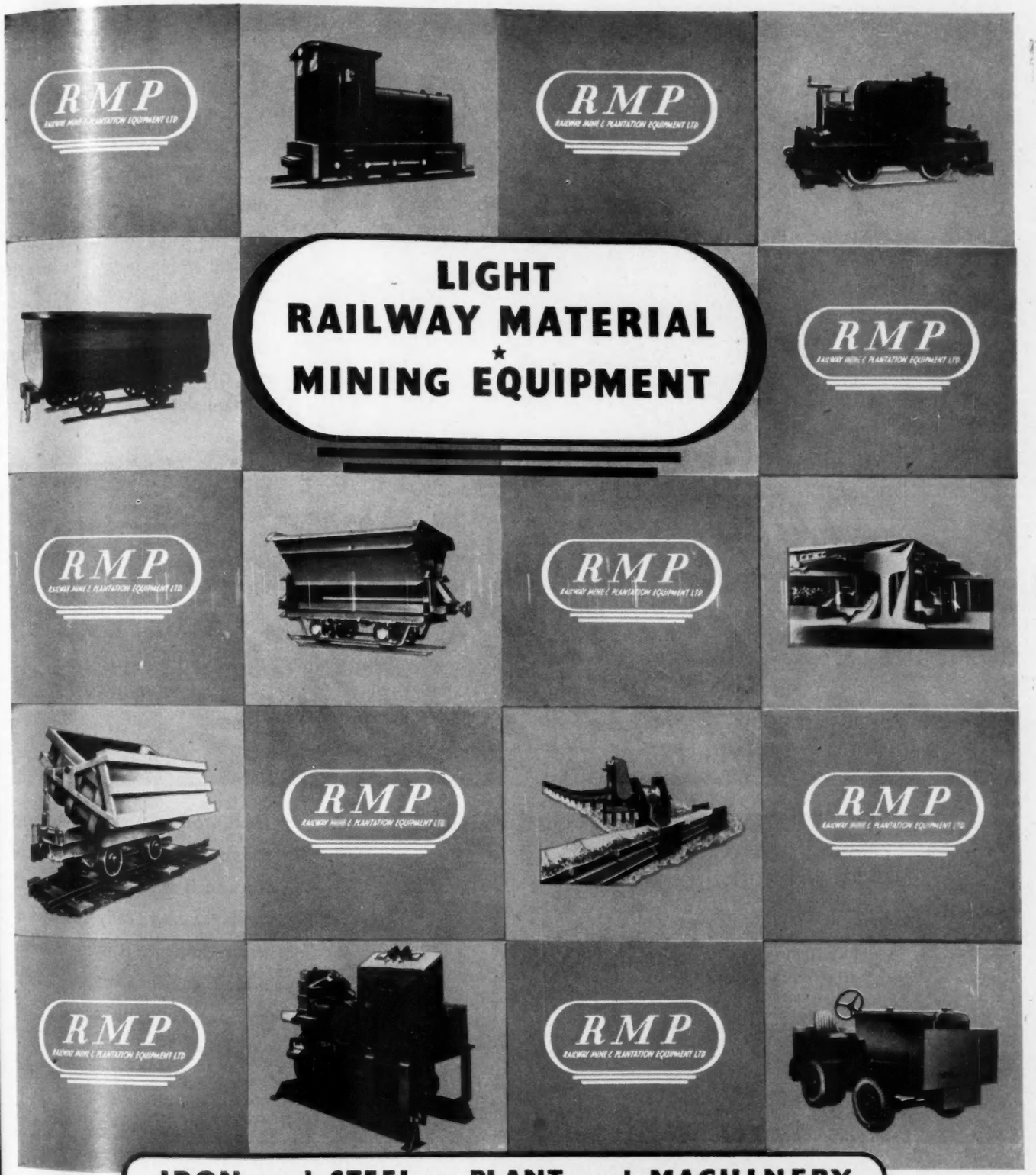
This new wall chart gives dimensional details for immediate reference, of the more commonly used standard welds to BS499.

Ask our representative or write to our Publicity Department for a copy.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

Member of the AEI group of companies

Electrodes for Every Purpose



IRON and STEEL – PLANT and MACHINERY

RAILWAY MINE & PLANTATION EQUIPMENT LTD.

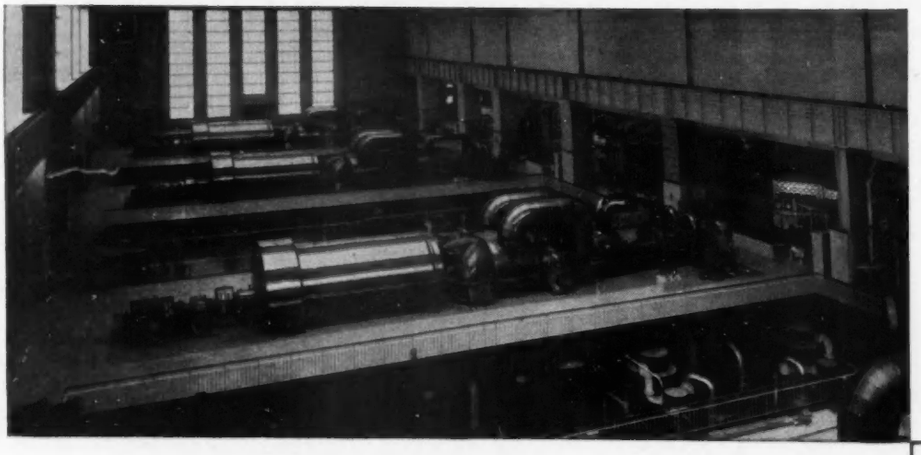
IMPERIAL HOUSE · DOMINION STREET · LONDON E.C.2.

Telephone: MONarch 7000 (20 lines) · Grams: Minplan Ave. London. · Cables: Minplan London.

Bottom half of Parsons steam turbine exhaust casting in Meehanite, weighing 18 tons 15 cwt. and subjected to vacuum.

LARGE AND DIFFICULT CASTINGS which, like this turbine exhaust casting, must be absolutely sound, vacuum-tight and machinable, require high standards of metallurgical control and foundry practice in their production. For such applications C. A. Parsons & Co. Ltd. *always* rely on Meehanite Metal. Experience has proved that no other iron can meet their exacting demands.

A 19 TON MASTERPIECE IN MEEHANITE!...



There are many types of Meehanite which provide important properties such as wear resistance, heat resistance and ready response to heat treatment. It is the function of the Meehanite Foundry to meet the Engineer's requirements.

Write for the new book

"MEEHANITE IN THE SERVICE OF INDUSTRY"

Cast Iron Can Do it-if it's

MEEHANITE REGD.

The Dependable Metal

MEEHANITE METAL FOUNDRIES AT YOUR SERVICE

C. A. Parsons and Company Ltd. Newcastle-on-Tyne, 6. **Qualicast (Ealing Park) Ltd.** London, W.5. **Richards Foundries Limited.** Leicester. **Southern Foundries Ltd.** Waddon, Croydon, Surrey. **Winget Limited,** Rochester. **Ashmore, Benson Pease and Co.** Stockton-on-Tees. **The Butterley Company Limited.** Ripley, Derby. **Cameron and Robertson Limited.** Kirkintilloch. **Carmichael Brothers Limited.** Nile Street, South Shields. **Goulds Foundries Limited.** Cardiff and Newport, Monmouth. **John Harper (Meehanite) Limited.** Willenhall, Staffordshire. **G. M. Hay and Company Limited.** Glasgow.

THE INTERNATIONAL MEEHANITE METAL CO. LTD. MEERION HOUSE, 4 DOWNSIDE, EPSOM, SURREY. Telephone: Epsom 3507

In Arctic Cold

or

Desert Heat

VOKES

filters give maximum protection

Pioneers of Scientific Filtration

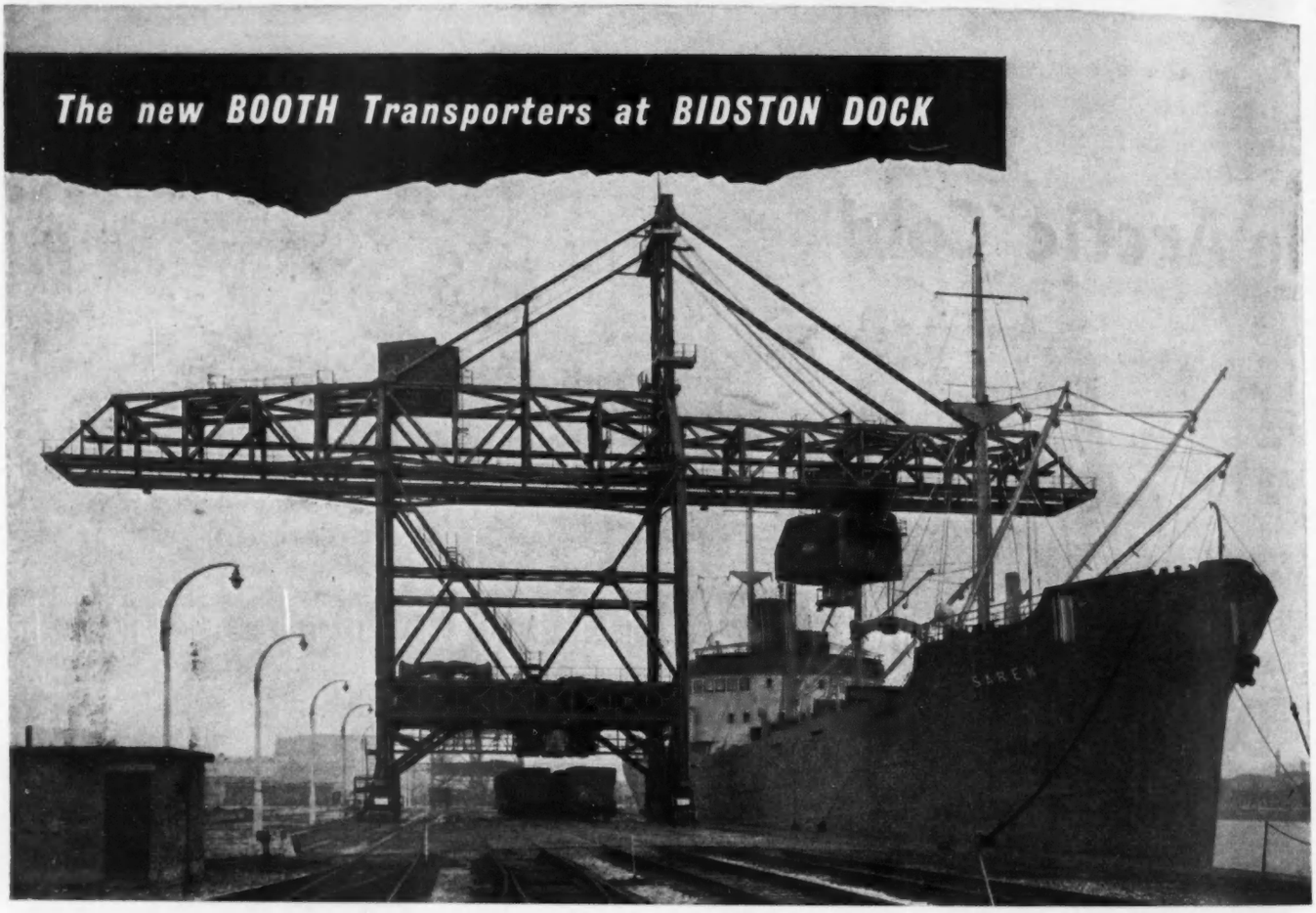
When operating temperatures are abnormally low, it is the first few minutes that count—and because of the intrinsic efficiency and large surface area of the Vokes felt fabric element, the direct-flow device—which must unfailingly operate when the oil is highly viscous, remains open for the absolute *minimum* of time, ensuring that unfiltered oil is not allowed to circulate over dangerously long periods. And at the other end of the temperature scale, Vokes filters give the same unfailing protection—that is why they were chosen to protect equipment on all the major Middle East Pipe Lines.

VOKES LIMITED, GUILDFORD, SURREY London Office: 123 Victoria Street, Westminster, S.W.1

REPRESENTED THROUGHOUT THE WORLD · VOKES (CANADA) LTD. TORONTO · VOKES AUSTRALIA PTY. LTD. SYDNEY

V192

'CLYDE-BOOTH Speeds Ore Unloading!



Two 12½ ton Ore Unloaders supplied to Messrs. Rea Ltd., for use on Bidston Dock.
Consulting Engineer: G. Shoosmith Esq., M.A. M.I.C.E., M.I.Mech.E., M.I.Mar.E.

THE TWO ORE UNLOADERS recently put into service for Messrs. Rea Limited, at Bidston Dock, Birkenhead, embody many features which are considered ideal engineering practice.

They are designed to discharge, at very high rates, the cargoes of ore ships including the largest vessels which can enter the dock.

From a wide experience in designing and building all types of crane installations, we shall be pleased to submit proposals and designs to suit your requirements.

CLYDE BOOTH

CLYDE CRANE & BOOTH LTD
incorporating

Clyde Crane & Engineering Co.,
MOSSEND, Lanarkshire.
Telephone: Motherwell 354/5. Telegrams: "Clyde," Motherwell.

Joseph Booth & Bros.,
Union Crane Works, RODLEY, Leeds.
Telephone: Pudsey 3168. Telegrams: "Cranes," Rodley.

POST-MORTEM

Now and again we turn out a casting that is not up to standard — a "scrapper". As far as possible we try to prevent all such castings from leaving our works, and to that end we operate a system involving 100% inspection of all castings before despatch.

Every Friday at four o'clock we hold a meeting of senior executive staff, from director level down, to discuss matters relating to the steel foundry. At this meeting, any scrappers from the previous week's work are the subject of a very searching post mortem examination.

This is a ruthless process, but it is essential if we are to secure the highest standards of quality, finish and dimensional accuracy, and ensures that only castings, in all respects satisfactory to our customer, leave our works.

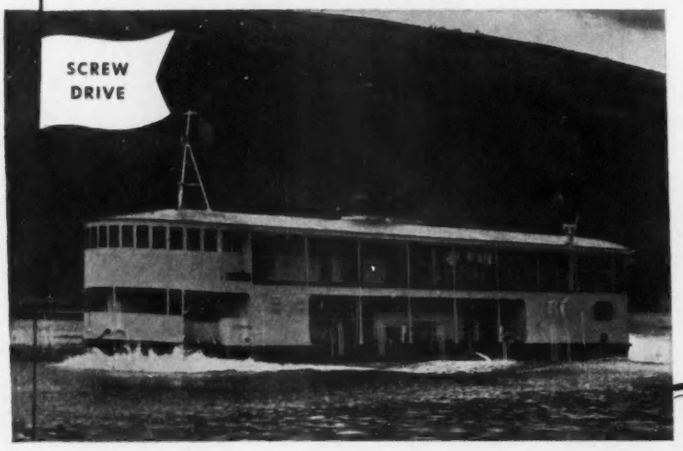
Brown Lenox

These four castings, illustrated above, fairly represent the standards of quality, finish and dimensional accuracy that we attain in our steel foundry. We specialise in steel castings to B.S. 592, Grades A, B and C; B.S. 1617, Grades A and B; B.S. 1760, Grade A; B.S. 1456, Grades P and R, and from a few lb. up to 2 tons in weight.

BROWN, LENOX & COMPANY LIMITED

Associated Company: Brown, Lenox & Co. (London) Ltd., Millwall E.14

PONTYPRIDD GLAMORGAN



Yarrow design and construct all types of shallow draft vessels

'TAGOOG'—one of six quarter wheel diesel pusher tugs for service in the Sudan.

'CHINMA'—one of six twin screw tunnel type diesel passenger vessels for service in Burma.

YARROW

AND COMPANY LIMITED · GLASGOW

THE

ALLBRIT

DRAFTING MACHINE

Combines all the functions of the T-Square, Set Square, Parallel Rule and Protractor.

It is definitely established that by its aid drawing can be made with greater accuracy and less fatigue, resulting in increased output.

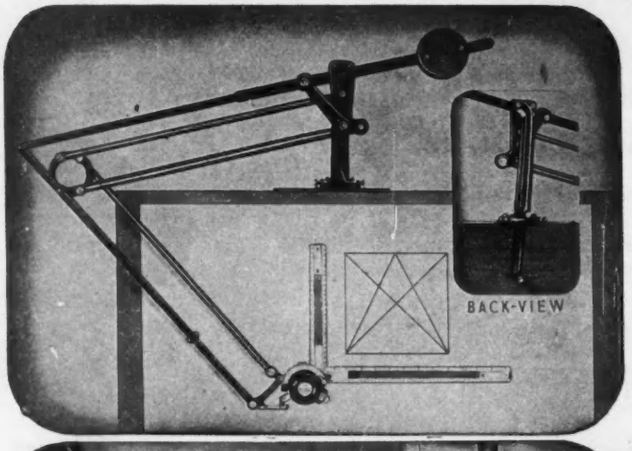
A TIME-SAVER IN THE DRAWING OFFICE

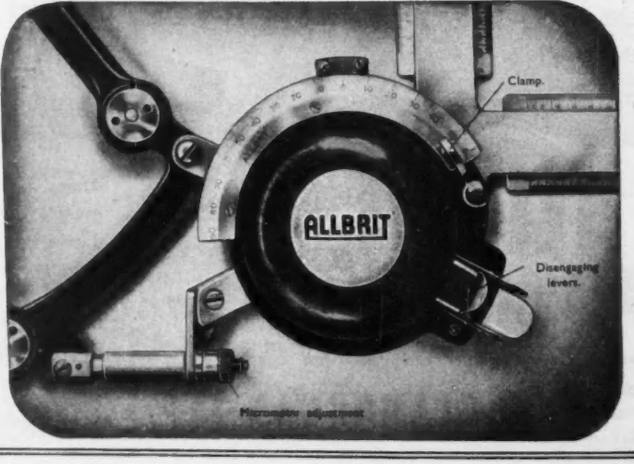
The protracted head (see close-up illustration below) is made throughout in steel, apart from the handle and divided arc, and is dull chromium plated to prevent the soiling of paper. Maximum strength combined with light weight. All the parallelogram bearings contain ball-races, and are adjustable for wear.

SOME EXCLUSIVE FEATURES:

- EASY MANIPULATION OF THE HEAD. The disengaging levers for changing the angles of the head are located immediately by the thumb when the handle of the machine is grasped.
- ANGULAR LOCATION. Accurate and positive location of the scales at all principal angles by means of a special hardened steel cam engaging a notched plate by means of a spring and wedge action.
- ACCURACY. Extreme accuracy of the notch plate assured by a final grinding against an optical micrometer in a machine of our own design and manufacture.
- ABSENCE OF FRICTION, due to special generously proportioned hardened steel ball-races, adjustable for the elimination of back lash.

FULL DETAILS GLADLY SENT UPON REQUEST





STANLEY

Manufacturers of

Theodolites, Levels, Planimeters, Integrators, Pantagraphs, "Fuller" Calculators, Drafting Machines Drawing Instruments, Surveying and Drawing Office Equipment and EVERYTHING FOR THE SURVEYOR & DRAUGHTSMAN

Write for descriptive leaflets (Enr. 51)

W. F. STANLEY & Co. LIMITED

Head Office and Main Works.

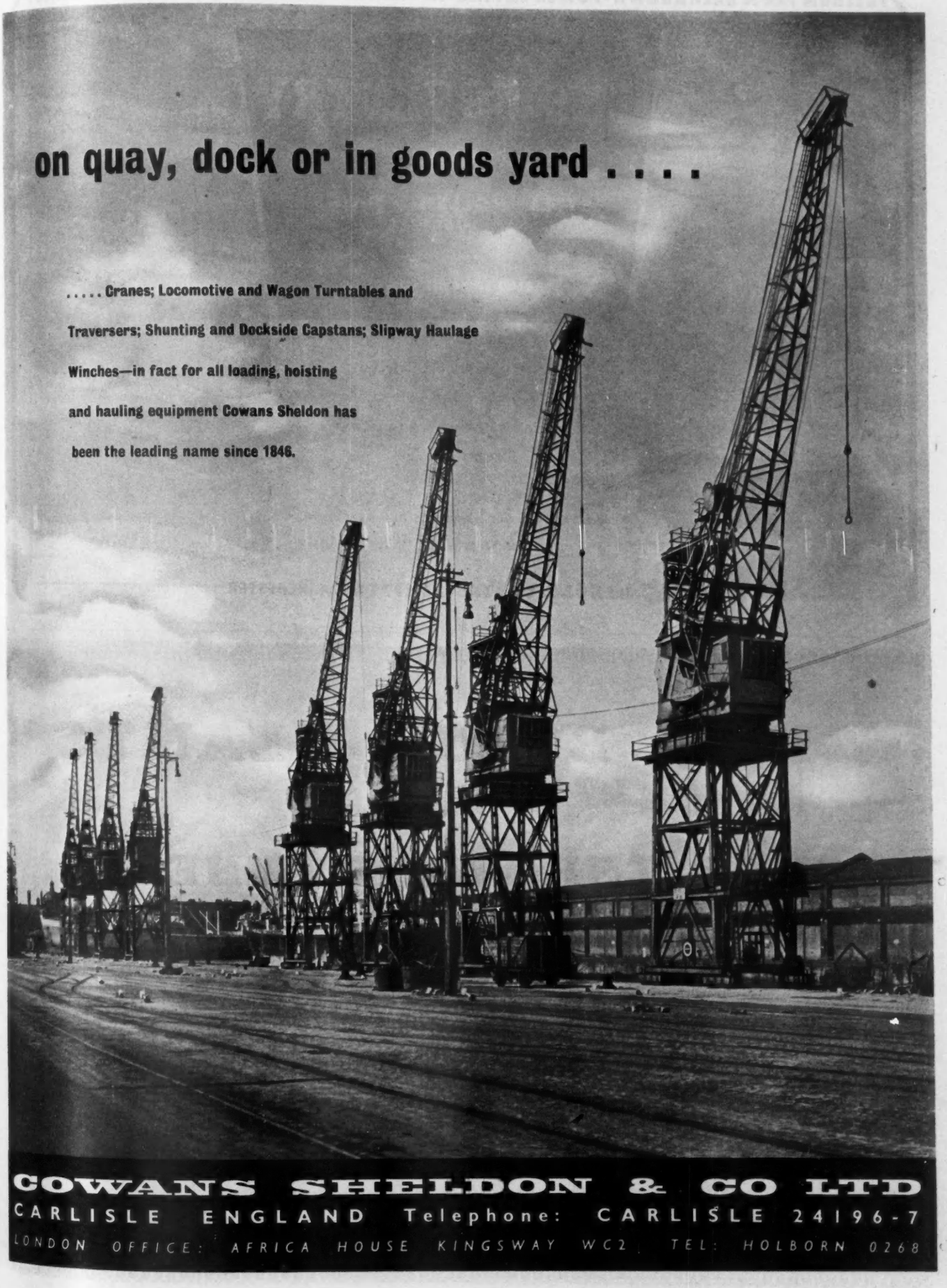
NEW ELTHAM, LONDON, S.E.9.

'Phone: Eltham 3836. 'Grams: "Turnstile Phone," London.

Showrooms:—
79/80, High Holborn, London, W.C.1
('Phone: Holborn 2684)

Branches:—
13, Railway Approach, London Bridge, London, S.E.1.
('Phone: Hop 0871)

52, Bothwell Street, Glasgow C.2.
('Phone: Central 7130)


on quay, dock or in goods yard . . . .
. . . . . Cranes; Locomotive and Wagon Turntables and
Traversers; Shunting and Dockside Capstans; Slipway Haulage
Winches—in fact for all loading, hoisting
and hauling equipment Cowans Sheldon has
been the leading name since 1846.
COWANS SHELDON & CO LTD
CARLISLE ENGLAND Telephone: CARLISLE 24196-7
LONDON OFFICE: AFRICA HOUSE KINGSWAY WC2 TEL: HOLBORN 0268

FREEDOM FROM BREAKDOWN · POWER SAVING · INCREASED PRODUCTION · LASTING EFFICIENCY

THE COVENTRY
MARK 5
STEEL ROLLER CHAINS & WHEELS

(Replacing Malleable and Pressed Steel Chains)

Treated to resist corrosion

No. 180 488. 1·15" pitch, replacing Malleable 32

No. 180 519. 1·375" pitch, replacing Malleable, 42, 50

No. 180 538. 1·58" pitch. replacing Malleable, 52

No. 180 570. 1·63" pitch, replacing Malleable, 55

No. 180 581. 1·63" pitch, replacing Malleable, 45

No. 180 558. 1·65" pitch, replacing Malleable, 62, 72½

No. 180 671. 2·297" pitch, replacing Malleable, 57, 67, 77.

No. 180 708. 2·609" pitch, replacing Malleable, 75, 78, 88.

For slow-speed driving, conveying and elevating under rough exposed conditions.

KI and MI attachments are available

Write for leaflet Ref. 116/101

RENOLD CHAINS LIMITED · MANCHESTER

SHOT BLAST PLANTS
with
SHOT THROWING WHEELS
or
AIR NOZZLES

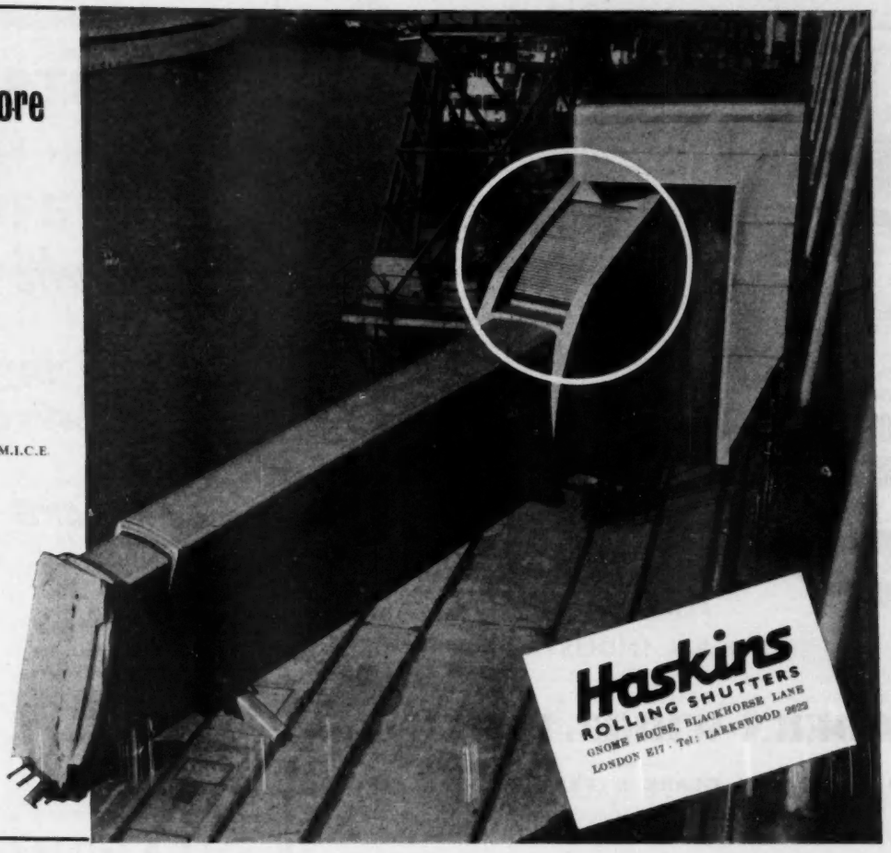
Over 50 years experience embodied in design and manufacture

ST. GEORGES ENGINEERS LTD., ORDSALL LANE, MANCHESTER 5

Telephone TRAfford Park 1207 (4 lines). Telegrams : "Georgic" Manchester 5

From Ship to shore thro' a corridor!

Telescopic gangway installed at the Ocean Terminal Docks is illustrated by courtesy of the British Transport Commission. As the tide rises and falls Haskins **Interlocking Shutters** keep the corridor weather proof. Docks Engineer: J. H. Jellet, O.B.E., M.I.C.E. Apart from their normal purpose of protecting industrial openings Haskins **Interlocking steel rolling shutters** are constantly helping engineers in numerous ways such as Fire Doors, Swarf Conveyors, Escalator Fire Protection, Core Ovens, Drying Kilns, etc.

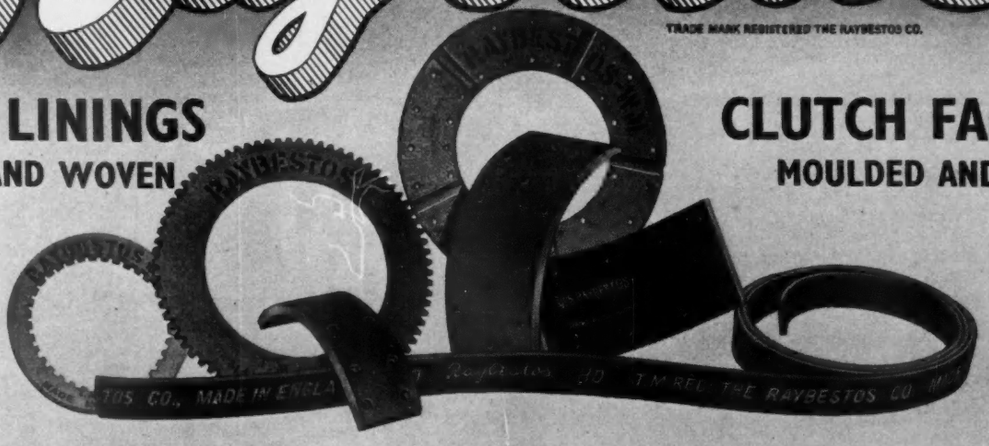


Raybestos

TRADE MARK REGISTERED THE RAYBESTOS CO.

BRAKE LININGS
MOULDED AND WOVEN

CLUTCH FACINGS
MOULDED AND WOVEN

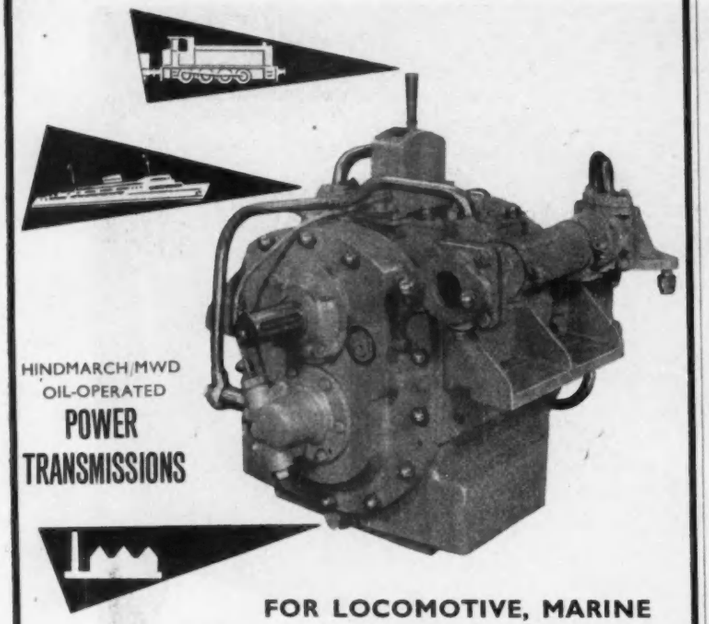


MADE IN ENGLAND

RAYBESTOS-BELACO LIMITED
EVERITE HOUSE · SOUTHWARK STREET · LONDON, S.E.1

Telephones:
WATerloo 7031-4, 3842-7

EXCLUSIVE DISTRIBUTORS OF RAYBESTOS PRODUCTS IN THE EASTERN HEMISPHERE



HINDMARCH/MWD
OIL-OPERATED
POWER
TRANSMISSIONS

FOR LOCOMOTIVE, MARINE
AND ALL INDUSTRIAL PURPOSES

MODERN WHEEL DRIVE LTD.

Associated with
OIL-OPERATED GEARS & TRANSMISSIONS LTD.

Technical Office: LINDO LODGE, CHESHAM, BUCKS.
Telephone: CHESHAM 406 Works: SLOUGH, BUCKS. Telegrams: OILOPRATED CHESHAM.

Hydraulic

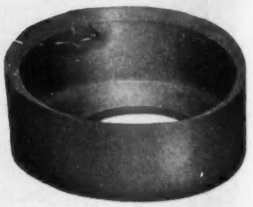
HILLMAN DUDLEY

Leathers

With 100 years of experience behind them, Hillman Leathers and Rubbers are well known for their efficient service and extra long life.

Hat or Pump Leathers

Ram or "U" Leathers



Cup or Bucket Leathers

J.&A.HILLMAN LTD DUDLEY, WORCS.
M-W. 52

WISEMAN

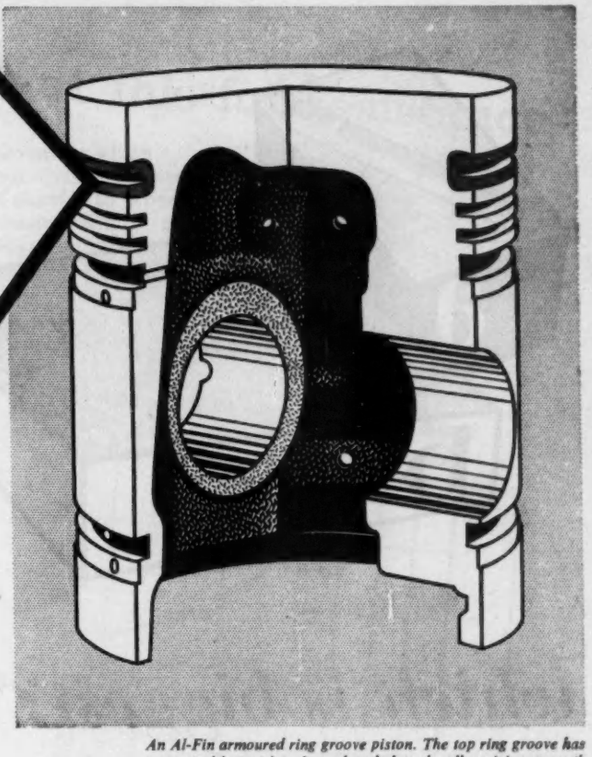
AT NANTGARW

This is still another colliery installation where Wiseman gear units are being employed to transmit power to the coal conveyors. Wherever strenuous and constant work is expected, the sturdy reliability of Wiseman units has proved a good investment. Ask our engineers to co-operate in solving your own power transmission problems.

ALFRED WISEMAN & CO. LTD.
GLOVER STREET, BIRMINGHAM, 9

London Office: CARLISLE HOUSE, 8 SOUTHAMPTON ROW, W.C.1

WELLWORTHY AL-FIN
armoured ring groove
LONG LIFE PISTONS



An Al-Fin armoured ring groove piston. The top ring groove has an austenitic cast iron insert bonded *to the alloy giving strength where it is required, prolonging piston life by at least* 100%.

more than pay for themselves in the first year . . .

The average life of an Al-Fin Piston is at least 100% more than normal types. This double mileage saves you the cost of one overhaul *and* the cost of another set of pistons. To this can be added the further saving effected by keeping the vehicle on the road during the whole period. No wonder so many large fleet owners say, "*AL-FIN is the best investment yet*".

WELLWORTHY
AL FIN
The choice of the Expert

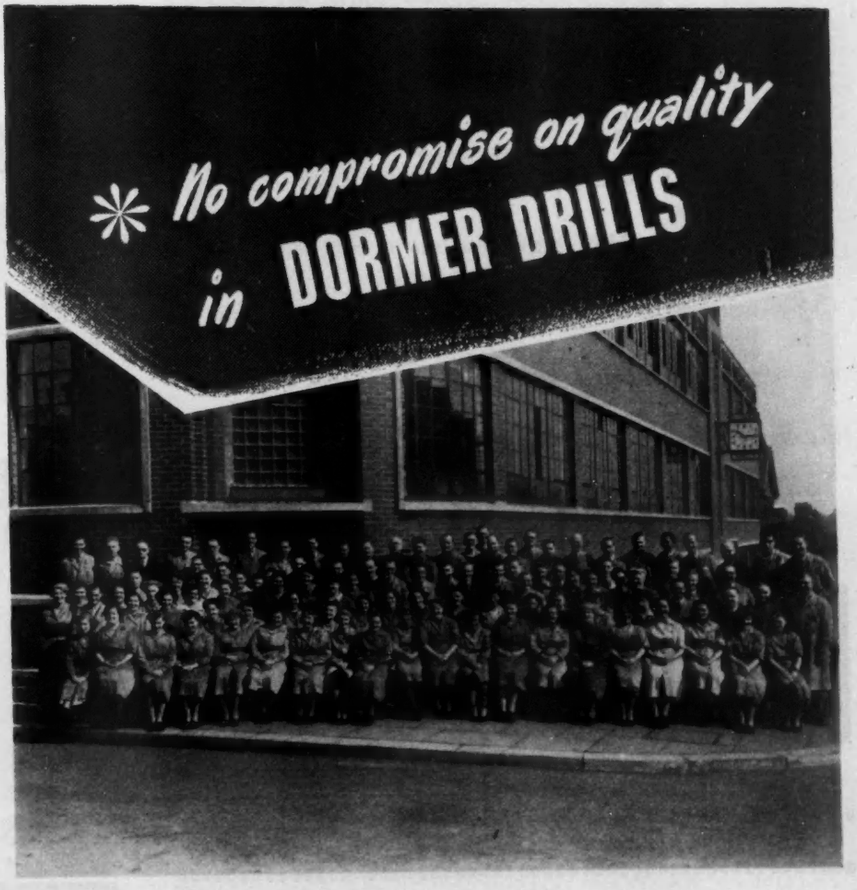
BONDED INSERT PISTONS WELLWORTHY LIMITED, LYMINGTON, HANTS

---

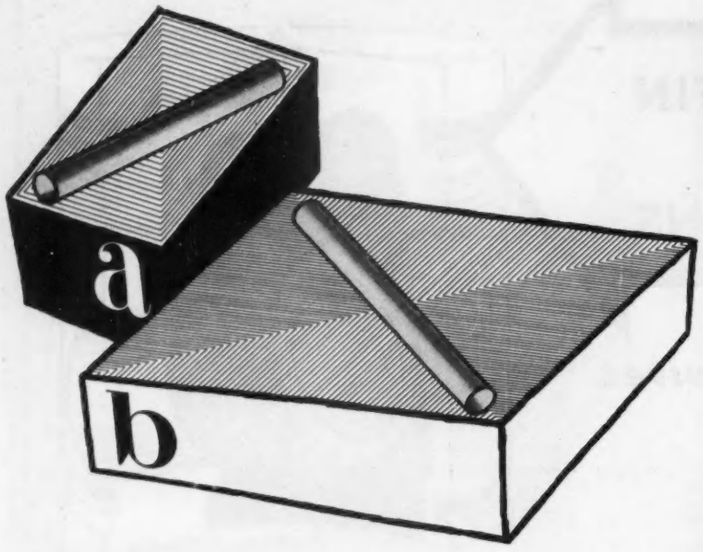
130 INSPECTORS
see to that!

WORKING UNDER IDEAL CONDITIONS
OUR INSPECTION STAFF CHECK EVERY
FEATURE OF EACH DORMER DRILL.
THIS STAFF ENSURE
THERE NEED BE NO LIMIT TO
YOUR CONFIDENCE IN . . .

DORMER



THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED
SHEFFIELD ENGLAND
DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS



*which is biggest?**

When it comes to seamless steel tubes there's no argument at all. The biggest—and strongest—tubes in Britain are pierced at Chesterfield on our 5,000 ton hydraulic piercing press. How big? 25 ft. long if you like; longer if you insist. With an internal diameter of (shall we say?) 39 inches. And as for strength, a working pressure of 4,000 lbs. per sq. inch is no more than you'd expect from a tube made by the Chesterfield process. With not a seam, not a weld, not a join in it. *If you want to know which is the bigger tube in the illustration—they're both identical.*

the biggest tubes are

CHESTERFIELD TUBES

the heavyweight of the (TI) group

THE CHESTERFIELD TUBE COMPANY, LIMITED, CHESTERFIELD, ENGLAND

CRC 37

SCRAP

for

COHEN'S

COHEN'S

for

SCRAP

THE 600 GROUP OF COMPANIES

GEORGE COHEN

SONS AND COMPANY LIMITED

RAW MATERIALS DIVISION

Experts in Scrap since 1834

BROADWAY CHAMBERS, LONDON, W.6

Telephone: Riverside 4141 · *Telegrams:* Coborn, Telex, London

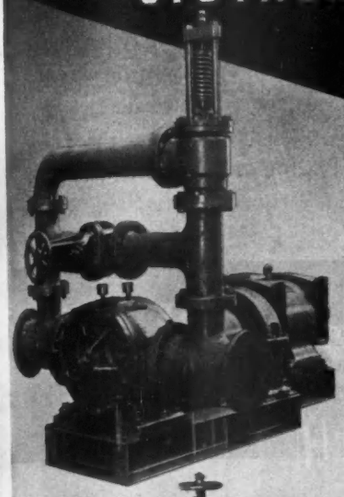
And at 600 Commercial Road, E.14 · Bidder Street, Canning Town, E.16

Bath · Belfast · Birmingham · Hebburn-on-Tyne · Leeds · Luton

Manchester · Sheffield · Swansea

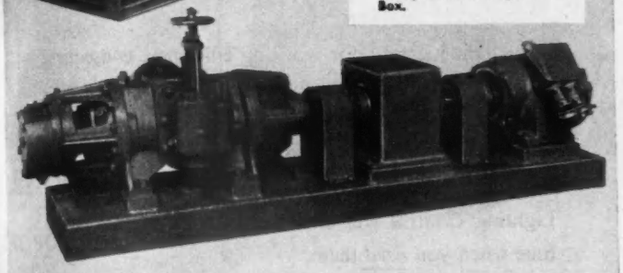
S&P LIMITED

PUMPS by STOTHERT & PITT LIMITED

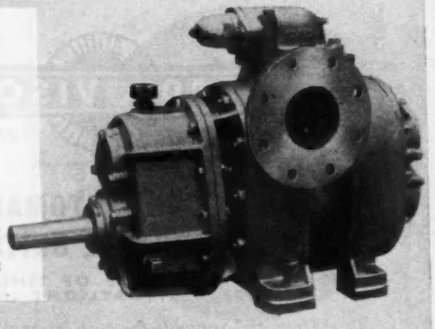


(LEFT)
Positive Acting Rotary Displacement Pump for the handling of Molasses and viscous fluids, electrically driven through totally enclosed Reduction Gear Box.

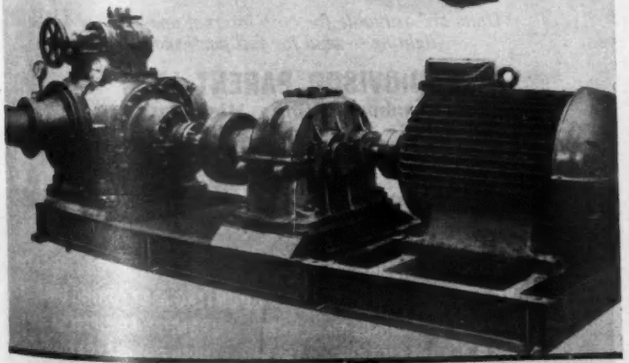
(BELOW)
Positive Acting Screw Displacement Spirit Pump electrically driven through Wall Box.



(RIGHT)
Positive Acting Screw Displacement Spirit Pump specially designed for fitting to Road vehicles.



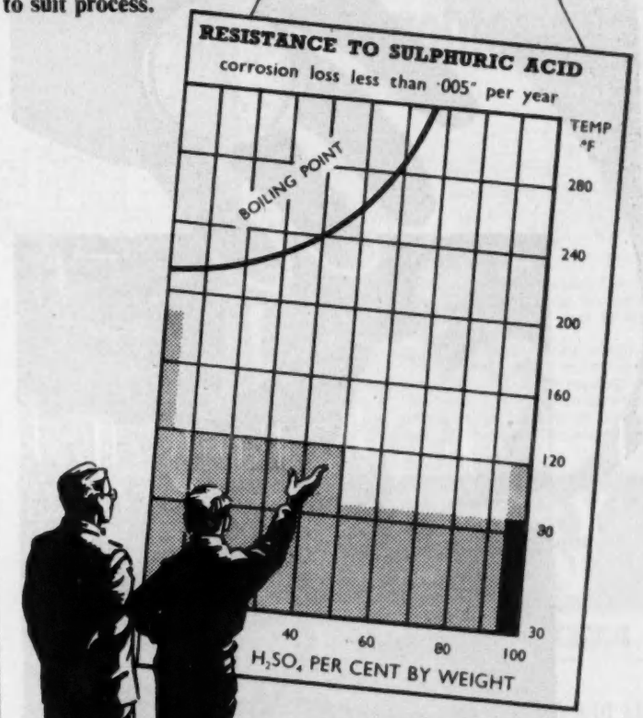
(BELOW)
Positive Acting Variable Output Guinard Rotary Piston Pump, electrically driven through Reduction Gear Box, for Oils of varying viscosity.



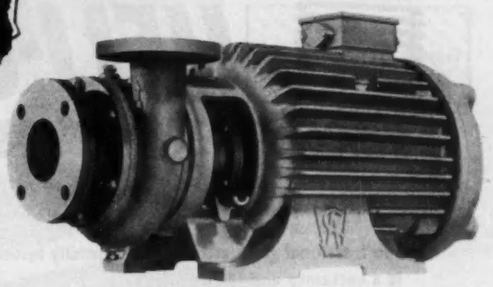
STOTHERT & PITT LTD
ENGINEERS • BATH • ENGLAND

look at this for resistance

A new achievement which opens up an extensive range of acids, alkalis and slurries to economical pumping coupled with the advantages of the Worthington-Simpson "Monobloc" construction—few parts—low costs—less wear—easy installation. Stuffing box packing and two types of mechanical seal interchangeable to suit process.



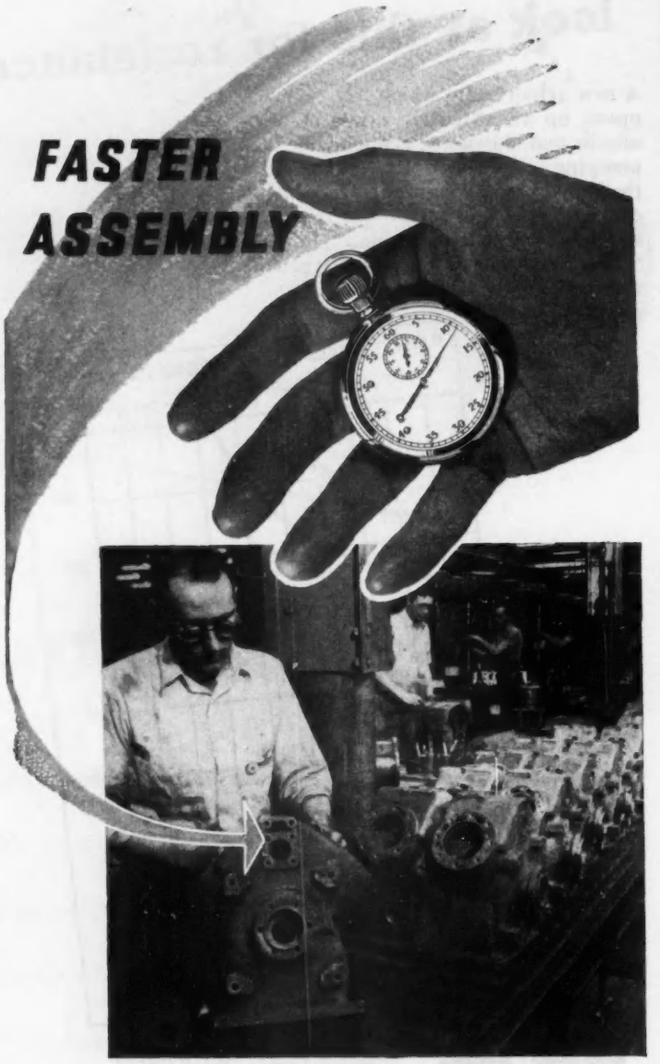
WORTHITE
18/8/3 & WORTHITE



MONOBLOC
CHEMICAL PUMPS
IN WORTHITE OR 18/8/3 STAINLESS STEEL

put it to the test
write for WORTHITE or 18/8/3 1½ Specimen Discs and test these materials under your own site conditions

WORTHINGTON - SIMPSON
WORTHINGTON-SIMPSON LTD NEWARK — NOTTS



WITH...

HELI-COIL*

SCREW THREAD INSERTS

* REGD. TRADE MARK

No fractional gains either; substantially faster and surer assembly is a certainty and here's why:—

Fit Heli-Coil! and reduce number of fastenings required. Use set bolts (which can now be shorter) instead of double threaded studs and eliminate " worrying " cover plates, etc., into position.

Fit Heli-Coil! and reduce torque loading for same duty. Reduce the wall boss size—no counterbore needed. Use lighter materials and improve thread strength. *Fit Heli-Coil!* and have all the advantages of a polished, rolled, internal thread.

Please write for full information.

ARMSTRONG PATENTS CO., LTD.

BEVERLEY, YORKSHIRE.

WHY USE MORE LIGHT THAN YOU NEED

Very often lights are kept burning unnecessarily simply because *somebody* doesn't switch them off. It may not happen very often — it may not go on very long at a time — but these occasions add up to wasteful expenditure ; they are costing you money. Automatic Lighting Control will switch off your lights immediately they are not needed — this means you are using artificial light *only* when it is required.

WHY USE LESS LIGHT THAN YOU NEED

Poor light means poor working efficiency, consequent falls in production — and is one of the greatest contributory factors in accidents. There are many occasions owing to variations in daylight intensity when your factory or workshop lights *should* be on — Automatic Lighting Control will switch them on for you at the time when you *need* them.

RADIOVISOR
EST. 1927

PHOTO-ELECTRIC AUTOMATIC LIGHTING CONTROL UNITS

OPERATE IRRESPECTIVE OF TIME—CONTROLLED ENTIRELY BY DAYLIGHT INTENSITY.

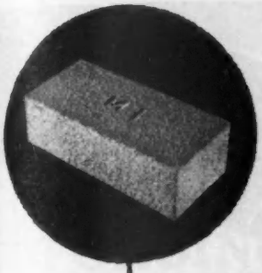
Units are available for both internal and external lighting — send for full particulars

RADIOVISOR PARENT LTD.,
Stanhope Works High Path,
London, S.W.19.
Tel: CHErrywood 3351

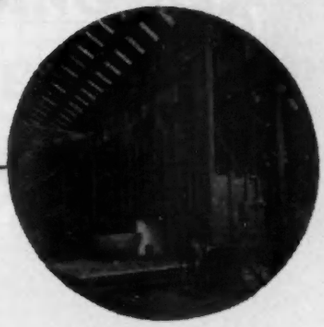
Radiovisor Photo-electric and Electronic controls include:

FLAMESTAT FLAME FAILURE CONTROL · SMOKE DETECTOR FIRE ALARM
SMOKE ALARM AND RECORDER · COUNTING & BATCHING UNIT
INVISIBLE RAY BURGLAR ALARM · TURBIDITY EQUIPMENT
HOPPER & BUNKER LEVEL CONTROL · PRINT REGISTRATION
PHOTO-ELECTRIC SAFETY GUARD · FACTORY LIGHTING CONTROL
AUTOMATIC RADIATION PYROSTAT · AUTOMATIC DOOR OPENING

The First name in photo-electric controls

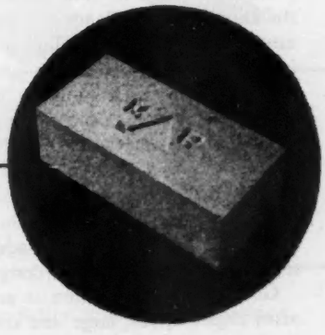


ow heat storage
urnace linings



igh temperature
ouldable and
astable
aterials

ricks that
esist spalling

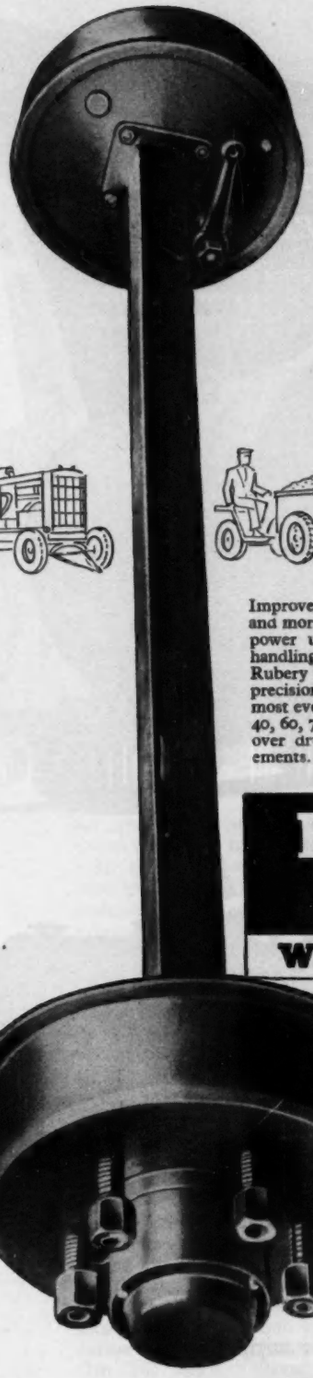


hings about
which it can pay
ou handsomely
o consult . . .

MORGAN
Refractories

HIGH DUTY AND INSULATING BRICKS — CASTABLES AND MOULDABLES — TUBES AND HOLLOW WARE

For further information please write to:—
MORGAN REFRACTORIES LTD., NESTON, WIRRAL, CHESHIRE. TEL: NESTON 1406 NE 109

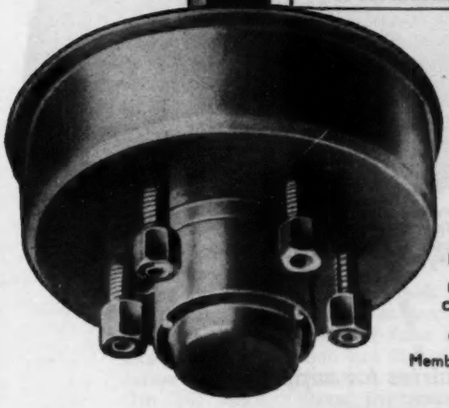


Solving weighty problems!

Improved production methods demand more and more heavy mobile equipment including power units, mobile machinery and factory handling trucks and trailers.
Rubery Owen has developed a wide range of precision-built Wheels and Axles suited to almost every type of job. Maxium loadings 20, 40, 60, 70, and 80 cwt. Standard track width, over drums, 72 ins or to customers' requirements. Full details available upon request.

RUBERY OWEN

WHEELS & AXLES



RUBERY OWEN & CO. LTD.,
P.O. Box No. 10, Darlaston,
Wednesbury, Staffs.

Telephone:
James Bridge 3131 (32 lines)

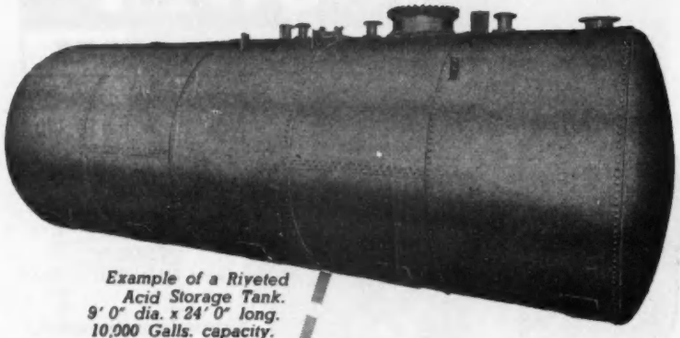
EXPORT DEPARTMENT:
KENT HOUSE, MARKET PLACE,
OXFORD CIRCUS, LONDON, W.1

Member of the Owen Organisation

ENGINEERS TO THE CHEMICAL AND ALLIED INDUSTRIES

also specialists in the production of welded fabrications, riveted work etc.

The two sections of a Deodoriser leaving our Works. Thirteen of these units have been supplied, installed and site welded at a new Refinery.



Example of a Riveted Acid Storage Tank. 9' 0" dia. x 24' 0" long. 10,000 Galls. capacity.

We invite your enquiries for supplies involving the use of . . .

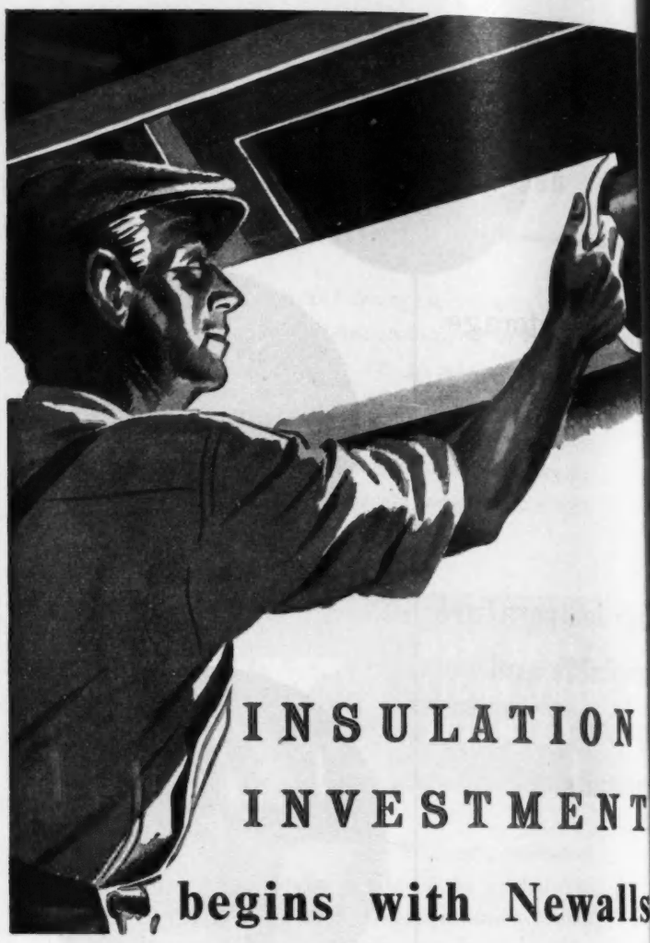
STORAGE TANKS PANS CONDENSERS WASHERS
PRESSURE VESSELS STILLS HEAT EXCHANGERS
GAS MAINS JACKETED VESSELS COLUMNS
AUTOCLAVES PIPE & VALVE WORK MIXERS
SILOS KEIRS EXPANSION JOINTS

RILEYS OF BATLEY

We undertake Design, Construction and Site Erection of Complete Plants or Single Units

A. J. RILEY & SON LIMITED

VICTORIA WORKS, BATLEY, YORKSHIRE.
Telephone: BATLEY 657 (3 lines). Telegrams: BOILERS BATLEY



INSULATION INVESTMENT begins with Newalls

ALL OVER THE COUNTRY our contracting staffs, working from 8 major depots in the main centres, are at work. A power station on the North East Coast . . . a cold store in Glasgow . . . a chemical works in Sout Wales . . . an industrial boiler installation in the Midlands . . . these are typical contracts. The men on the job are employing first rate materials — Newalls insulation specialities, which are manufactured to cover all temperature ranges from minus 300°F up to over 2,000°F. But they bring more than such materials to the job. Newalls make a point of studying the factors affecting the application of their materials, so that performance of the insulation has already been pre-determined before the contract has been started. This, coupled with a background of thousands of completed contracts using all types of insulation, adds up to an experience which supplements and transcends designs and specifications.

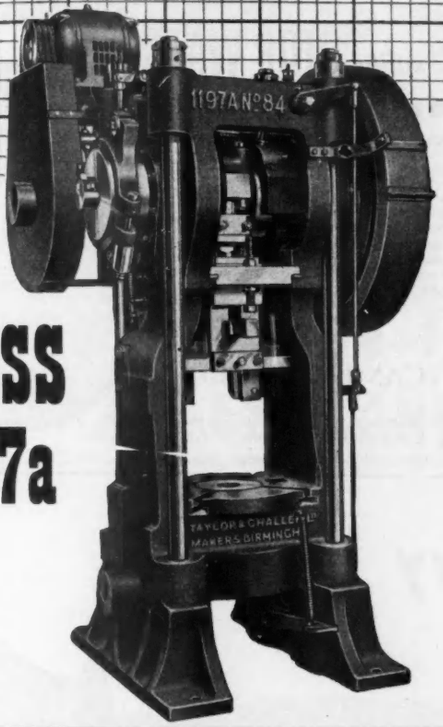
Good thermal insulation *is* an investment — that's why so many organisations, large and small, turn to Newalls for technical advice and consultation.

Where there's a problem of HEAT INSULATION there's a job for

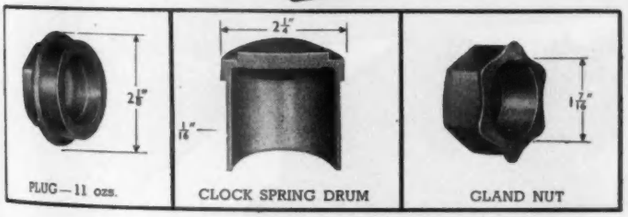
Newalls

NEWALLS INSULATION CO. LTD. *Head Office:* WASHINGTON, CO. DURHAM
A member of the TURNER & NEWALL ORGANISATION
Offices and Depots at LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, BRISTOL & CARDIFF. *Agents and Vendors in most markets abroad.*

PRESSES FOR HOT FORGING TO CLOSE-LIMITS



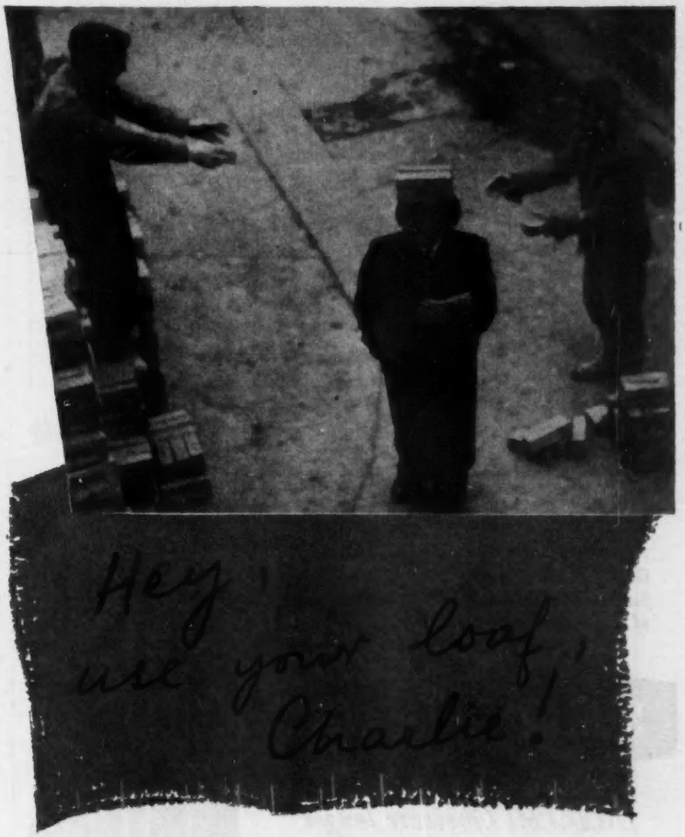
PRESS 1197a



These presses have the rigidity, speed and accuracy essential for hot forging, with a uniform finish, brass and other non-ferrous alloys. Press 1197A gives a pressure of 100 tons, and the examples illustrated are typical brass forgings which it makes in closed dies. We make similar presses for this work up to 500 tons capacity.

TAYLOR & CHALLEN LTD.

BIRMINGHAM 19



An extreme case of faulty distribution, no doubt, and one so obvious as to be almost absurd.

In the distribution of steam there are, in our experience, equally absurd but much less obvious examples. Very often the generation end and the processing end show good practice, but the essential link between them is given too little thought. *In many cases, twenty-shillings-worth of steam at the boiler has become about eighteen-shillings-worth at the other end.*

No one would tolerate a mechanical type of conveyor which allowed one-tenth of the raw material it was carrying to fall off. But this often happens with that costly raw material, steam.

Proper steam distribution calls for special attention to *pipe sizing*, *mains drainage* and *general layout*.

Undersize steam mains cause steam starvation, and oversize mains raise the cost of installation and lead to excessive heat loss by radiation.

Ill-drained mains allow water to get mixed with the steam, with consequent heat loss, and lead to water-hammer and water-logging.

Bad layout of mains can diminish the value of good practice and good equipment at various points.

Lack of proper regard for these important matters means lower production and higher costs. For this reason we have produced an Information Sheet (No. 16) called "Steam Distribution" which goes pretty fully into the essential link between boiler and process plant. Among other things, it offers a simple method of pipe sizing based on a formula proved in use to be very accurate.

The request slip below will bring you prompt evidence of whether you are yourself dropping a few bricks.

SPIRAX SARCO

SPIRAX-SARCO LTD., CHELTENHAM, Glos.

Phone: Cheltenham 5175-76 Grams: Spirax, Cheltenham

LONDON OFFICE: 28 Victoria Street, S.W.1 *Abbey 6101-3832*

REQUEST SLIP

To SPIRAX-SARCO LTD
CHELTENHAM, Glos.

Please send Information Sheet No. 16 "Steam Distribution"

NAME

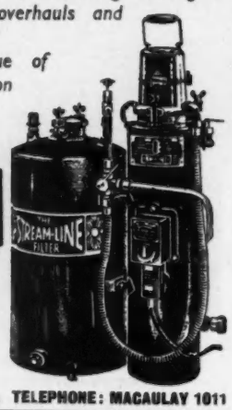
ADDRESS

EN 3656

The crank shaft is the heart of the engine and the lubricating oil is its heart's blood.

Stream-Line filters enable first grade lubricating oil to be kept always perfectly clean and used over and over again, increasing running efficiency and effecting a big saving in overhauls and maintenance.

Over 50,000 users are proving the value of Stream-Line filters in the economical operation of i.c. engines.

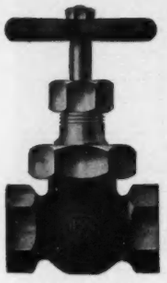


STREAM-LINE FILTERS

Make oil lubricate longer

STREAM-LINE FILTERS LTD, INGATE PLACE, LONDON, S.W.8. TELEPHONE: MACAULAY 1011

For the DISCRIMINATING *Engineer.*



"BSS 300"

Union Bonnet Valves

- SUITABLE FOR 300 lbs. STEAM W.P. AND TOTAL TEMP. OF 500° FAH.
- HEAVY UNION BONNET WITH CONE GROUND SEATING.
- NICKEL CLACK AND 'CAGE' TYPE NICKEL SEAT.
- GUNMETAL BODY OF ROBUST CONSTRUCTION.

Designed to give very long service under the most searching conditions.

• *SEND FOR SAMPLE FOR INSPECTION AND TEST* •

BRITISH STEAM SPECIALTIES LIMITED
FLEET STREET, LEICESTER.
LONDON · LIVERPOOL · GLASGOW · BRISTOL · MANCHESTER & NEWCASTLE-ON-TYNE.

First Quality **STOP WATCHES**

... For Industrial use

The stop watch illustrated is one taken from our latest catalogue of stop watches and chronographs. It is model 603—a type III 1/10th split second stop watch recording up to 30 minutes. The movement is of the highest grade and the very large size, 24 ligne with a dial diameter of 2¼in., facilitates the reading of the 1/10th second calibrations.

A copy of our catalogue showing a full range of first-quality watches, stop watches and chronographs will gladly be sent on request.

REPAIR SERVICE.—Our highly-skilled repair staff deals with all types of watches; repairs are guaranteed.

Timing Service Certification

CAMERER CUSS

Timing Division

Makers of good Clocks and Watches since 1788

At New Oxford St., London, W.C.1 *MUSeum 8968/9*

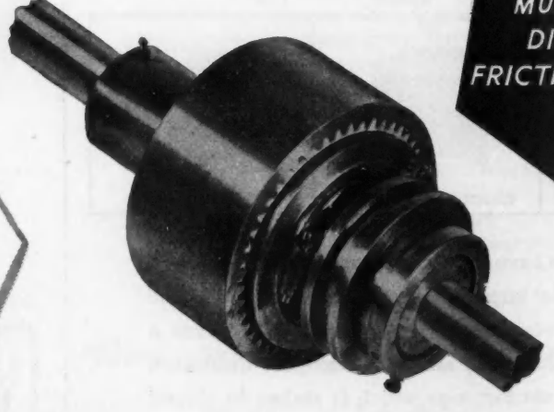
Our only other address: 91 Kingsway, W.C.2

DHB 2250

This is the clutch for heavy loads...

W. R. Anderton Multi-Plate Disc Type Friction Clutches are recommended where the power has to be transmitted in limited clutch dimensions, especially diameter. Available in sizes from 1 to 675 h.p., for coupling shafts or for fly-wheel operation. They drive either way, are free from axial thrust, are self-locking in or out of gear and are always in balance.

Also: The W. R. Anderton Single-Plate and Centrifugal Type Friction Clutches.



MULTI-PLATE DISC TYPE FRICTION CLUTCH

W·R·Anderton & CO LTD

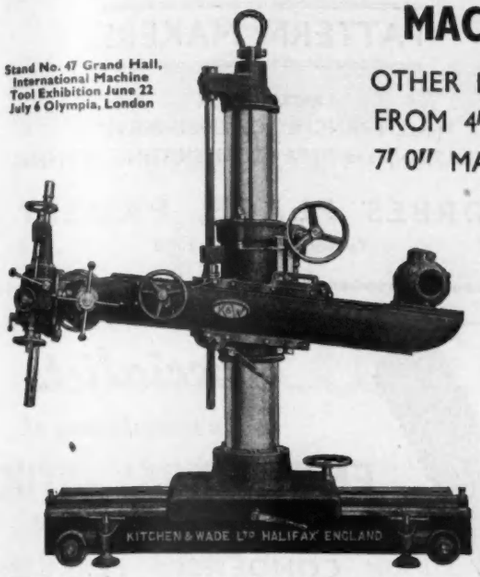
Established 1915

RAILWAY IRONWORKS, CASTLETON, ROCHDALE, LANCS.

Telephone: Castleton, 57288/9 Telegrams: Clutch, Castleton, Lancs.

U3 TYPE PORTABLE UNIVERSAL 6' 0" RADIUS RADIAL DRILLING MACHINE

Stand No. 47 Grand Hall, International Machine Tool Exhibition June 22 July 6 Olympia, London



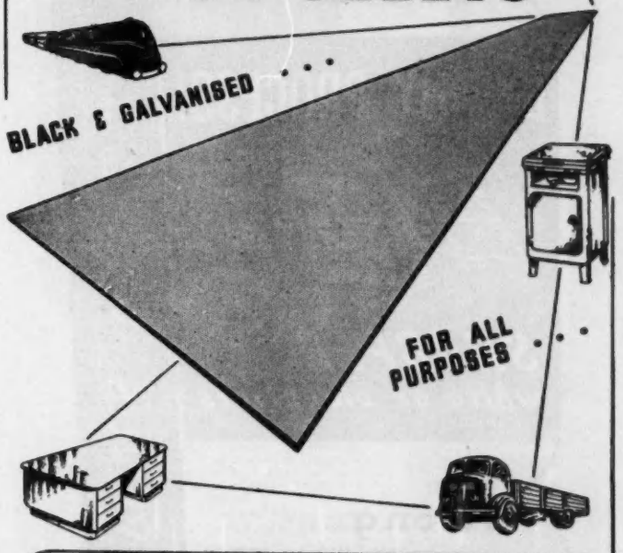
OTHER MODELS FROM 4' 0" TO 7' 0" MAXIMUM RADIUS

KITCHEN & WADE LTD
HALIFAX · ENGLAND

SM LIMITED

Makers of

The WIDEST **STEEL SHEETS**



SMITH & McLEAN · LTD
179 WEST GEORGE ST · GLASGOW · C·2
'PHONE CENtral 0442 · 'GRAMS "CIVILITY" GLASGOW

GEARS

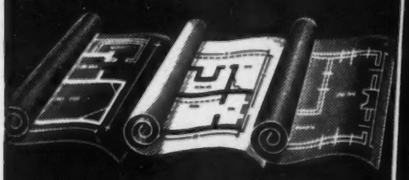
OF EVERY TYPE

SPECIALITY: "PEAK" NON-METALLIC PINIONS FOR SILENT RUNNING

THE **REAY GEARWORKS** LTD
HEBBURN · ON · TYNE, ENGLAND
Telegrams: Gears Hebburn Telephone: Hebburn 32204

NOW !

BY ANY PROCESS!



SHARPER
white or blueprints

THE PENCIL WITH THE CRACKLE FINISH

Strong...
Venus Pencil leads are pressure-proofed* for maximum strength

SMOOTH...
made by a special colloidal process* which removes all impurities

ACCURATE...
exactly graded in 17 different degrees of hardness

*Exclusive Venus Patents

Durable non-crumbling points; strong and smooth in action give lines uniform in weight and tone. Opaque lines for sharp, clear reproduction. No smudges. No "ghosts" from erasure. There's the right degree for your favourite paper. The result: sharper prints — by any process!

VENUS
DRAWING
PENCILS

Use also Venus Soft Pencil Eraser

VENUS PENCIL CO. LIMITED
LOWER CLAPTON ROAD, LONDON, E.5

J. F. Passe & Co.

(Sole Partner: JAS. F. PASSE)

PATTERN MAKERS

PATTERNS FOR
ALL BRANCHES OF ENGINEERING
ALTERATIONS and REPAIRS TO EXISTING PATTERNS

FORBES PLACE, PAISLEY
Telephone — PAI. 2553

Specialists
in the manufacture of
ENGINEERS' STUDS
STUDDING
CONDENSER FERRULES
AND
REPETITION TURNED PARTS

GEO. GALLOWAY & CO. LTD.
43 MIDDLESEX STREET, GLASGOW, S.1
Telephone: SOUth 1077-8-9 Telegrams: "TORPEDO," Glasgow, S.1

Let **SPARKLETS**
engineers get
the most out of your
DIE-CASTING DESIGNS
at the lowest cost

REMEMBER
Sparklets Pressure Die-Casting will:
cut your piece price costs; reduce machining and assembly operations with increased strength and improved appearance of the casting.

For quotation without obligation
send blueprints, specifications, or sample castings for expert appraisal, backed by over 40 years' experience with thousands of **PRESSURE DIE-CASTING** problems.

SPARKLETS PRESSURE DIE-CASTINGS

DEPT. D.4, SPARKLETS LIMITED, QUEEN STREET, TOTTENHAM, N.17

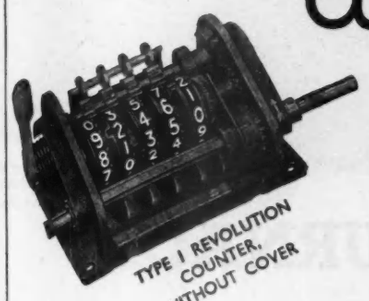
BRIGHT STEEL
ROUNDS · HEXAGONS
SQUARES · FLATS & SECTIONS

THE
HALESOWEN
STEEL Co. LTD.

HALESOWEN
Nr. BIRMINGHAM
HALESOWEN 1191

6 & 8 VICTORIA ST.
LONDON SW1 VIC 6098
8 CHATHAM ST.
MANCHESTER 1 CEN 0411

Albion



TYPE I REVOLUTION COUNTER, WITHOUT COVER

INDUSTRIAL
COUNTING
INSTRUMENTS
AND
MEASURING
MACHINES

Instrument Division,
B. & F. CARTER & CO. LTD., BOLTON 13, ENGLAND
Telephone: BOLTON 4344 (3 lines) Telegrams: Braiders, Bolton

the best instrument for the job...
— it must be ACCURATE

GAS THERMOSTAT

Your two year guarantee of faultless workmanship and material.

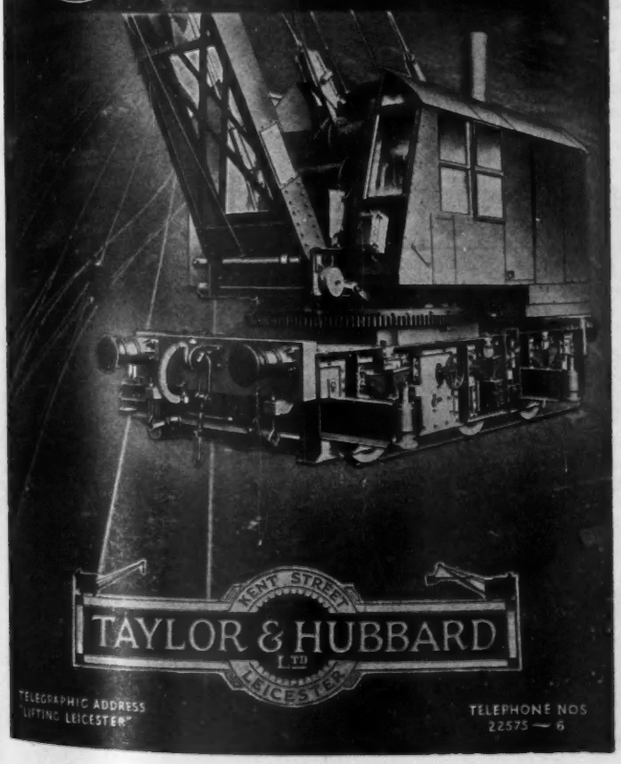
The ideal Gas Controller available in many ranges. Developed in conjunction with the North Thames Gas Board. Special Gas Council Test Report available on request.

Send for free illustrated catalogue of full range.

ARIC

THE ACCURATE RECORDING INSTRUMENT CO.,
GARTH ROAD, MORDEN, SURREY. PHONE: DERWENT 2211-2-3

T&H FOR CRANES



KENT STREET
TAYLOR & HUBBARD LTD
LEICESTER

TELEGRAPHIC ADDRESS "LIFTING LEICESTER"
TELEPHONE NOS 22575 — 6

BRIDGE
BANBURY MIXERS
For Quality Automatic Mixings and High Production

FOR MIXING AND MASTICATING
RUBBER natural & synthetic
PLASTICS
LINOLEUM
PAINTS & ASPHALT

Sizes and Capacities of Standard Bridge—Banbury Mixers

Size of Machine	Net Volume of Chamber		Approx. Batch Size in lb. Spec. Gravity x Factor	Motor H.p.	Motor Speed	Length	Floor Length	Space Width	Width
	cu. in.	c.c.			r.p.m.	ft. in.	mm.	ft. in.	mm.
B	103	1,690	Sp. G. x 2·5	7½	710	5 0	1,524	4 0	1,218
00	263	4,310	Sp. G. x 4	10	485	8 0	2,436	4 0	1,218
1	1,140	18,700	Sp. G. x 24	40	485	13 6	4,114	7 6	2,286
3A	4,562	74,750	Sp. G. x 100	100	485	15 0	4,572	8 0	2,436
9	11,443	187,500	Sp. G. x 225	200	485	33 0	10,100	9 6	2,895
11	15,469	253,500	Sp. G. x 300	250	485	27 0	8,228	11 0	3,352

Approx. 4 to 8 BATCHES PER HOUR ON RUBBER AND PLASTIC STOCKS on standard speed machines

In technical Associat on with Farrel-Birmingham Co. Inc. Ansonia Conn., U.S.A.

OTHER BRIDGE PLANT
Two Roll Mixers, Precision Calenders, Plastic Extruders, Laminated Plastic Presses, Cold Feed Extruders, Flood Lubrication Systems, Laboratory and Experimental Machinery.

FOR FURTHER DETAILS WRITE FOR NEW B.B. 200 BULLETIN
DAVID BRIDGE
AND CO. LTD.,
CASTLETON ROCHDALE
ENGLAND

Tel.: Castleton (Rochdale) 57216. Grams: Coupling Phone Castleton Lancs. Cables: Coupling Castleton, Lancs.
Specialist Engineers to the Rubber, Plastics and Associated Industries.
London Office: Broughton House, 6, 7, 8, Sackville Street, Piccadilly, London, W.1.
Tel.: Grosvenor 7430. Grams and Cables: Edaraceo Piccy London.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
AND
MARINE GEARS

BRITISH TWIN DISC
AND CLARIFIERS LTD.
AMBERLEY HOUSE,
NORFOLK STREET,
LONDON, W.C.2.

MARINE & INDUSTRIAL
DIESEL ENGINES
UP TO 1600 H.P.

THE
NEWBURY
DIESEL Co. LTD.
NEWBURY-ENGLAND

LOCOMOTIVES

Designers and Builders
of Steam, Diesel
and Diesel-electric
Locomotives

HUDSWELL, CLARKE
& COMPANY LIMITED
Railway Foundry, Leeds

LONDON OFFICE :
120/122 Victoria Street, S.W.1
TELEPHONE :
Victoria 6786

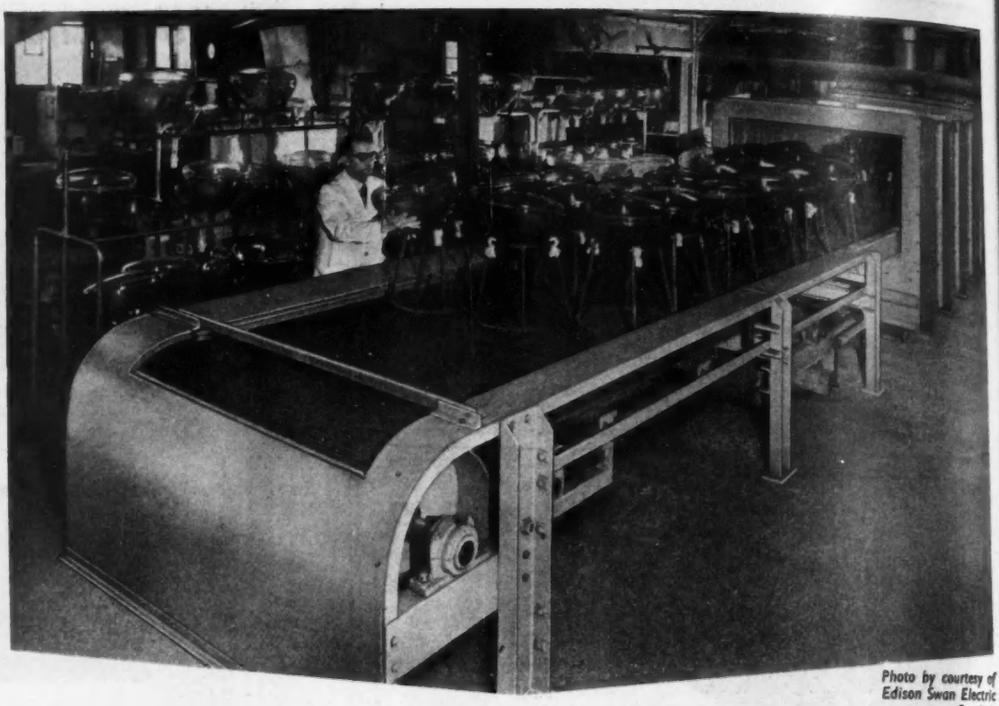


Photo by courtesy of Edison Swan Electric Co. Ltd.

LEHRS AND FURNACES
BY

We specialise in the design of continuous Lehrs and Furnaces with working temperatures up to 1150° C. Particular attention is given to economy in fuel consumption and our latest models have not only achieved a saving of approximately 30% in fuel costs but will also effect a substantial reduction in maintenance costs.
Whether you require a completely new installation or wish to improve your existing plant, our Engineers will gladly give you the benefit of their specialised knowledge and long experience, entirely without obligation. As well as installing the plant to your satisfaction we will instruct your own staff in its care and maintenance.
Send now for our latest Lehr and Furnace Catalogue.

MODERN MECHANISATION LIMITED
ELMSWOOD HOUSE, 52, BOUNDS GREEN ROAD, LONDON, N.11

WOVEN WIRE
for industry

any mesh
any metal
any purpose

BEGG, COUSLAND & CO. LTD.
SPRINGFIELD
WIRE WORKS
GLASGOW S.E.

SOCKET SCREWS..
10,000,000 IN STOCK

ALL SIZES

• ORDER NOW •

PLEASE WRITE FOR OUR MONTHLY STOCK LISTS

GEORGE H. ALEXANDER MACHINERY LTD.
"SOCKET SCREW DIVISION,"
GUNS LANE, WEST BROMWICH, STAFFS
Telephone : West Bromwich 1931 (5 lines) /Telegrams : "Viking, West Bromwich"

in the

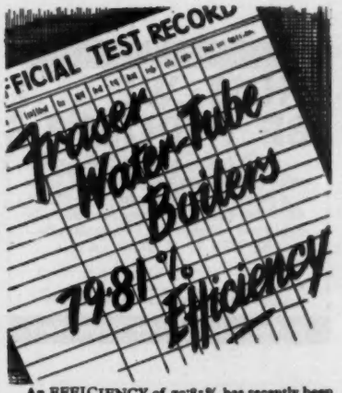
long run

the short cut is "SPEEDICUT"

Engineers' cutting tools of all types.

F B T Firth Brown Tools Ltd.
SPEEDICUT WORKS, CARLISLE STREET EAST, SHEFFIELD

VISIT OUR STAND No. 305, GRAND HALL GALLERY, AT THE MACHINE TOOL EXHIBITION, 22nd JUNE - 6th JULY



An EFFICIENCY of 79·81% has recently been shown on a FRASER WATER TUBE BOILER supplied to the British Admiralty. The Fraser Boiler can raise up to 10,000 lbs. of steam per hour.

Characteristic Advantages:
- HIGH THERMAL EFFICIENCY
- USE OF ANY PREDETERMINED FUEL
- LOWER MAINTENANCE COST
- LESS FLOOR SPACE NEEDED
- GREAT FLEXIBILITY OF OUTPUT

FRASER WATER-TUBE BOILERS
Illustrated Catalogue free on request.

FRASER & FRASER LTD
BROMLEY BY BOW LONDON E3

CONVEYOR SPECIALISTS SINCE 1906

Geo. ROBSON & CO. (CONVEYORS) LTD., Hodgson Street, SHEFFIELD
Phone: SHEFFIELD 27463/4

MEK-ELEK Engineering Ltd.,
17, Western Road, Mitcham, Surrey
MITcham 3072. Cables: Helelek, London.

GEORGE RUSSELL & Co LTD. MOTHERWELL

30TON LEVEL LUFFING CRANE
5 TON ELECTRIC WINCH
5TON STEAM GRAB CRANE
5TON OVERHEAD TRAV. CRANE
ESTB. CRANES OF ALL TYPES & SIZES 1865
35 TON COALING CRANE
20 TON ELECTRIC DERRICK
2TON CAPSTAN

MUST WE BE HEROES ?

And fight the Fire Fiend without NU-SWIFT? But why? Even the Royal Navy don't do that. Please send us details of your wonderfully rapid and reliable Fire Extinguishers—BEFORE IT IS TOO LATE!

Name.....

Address.....

Post NOW to Nu-Swift Ltd. 25 Piccadilly W.1.

In Every Ship of the Royal Navy

DAWSON & DOWNIE LTD
CLYDEBANK

Pumps for all Purposes

Ashore or Afloat

Steam
or
Electric Drive

•

TELEPHONE : CLYDEBANK 2271
TELEGRAMS: PUMPS, CLYDEBANK

STONE BREAKERS

CRUSHING ROLLS
SCREENS
ELEVATORS and
CONVEYORS

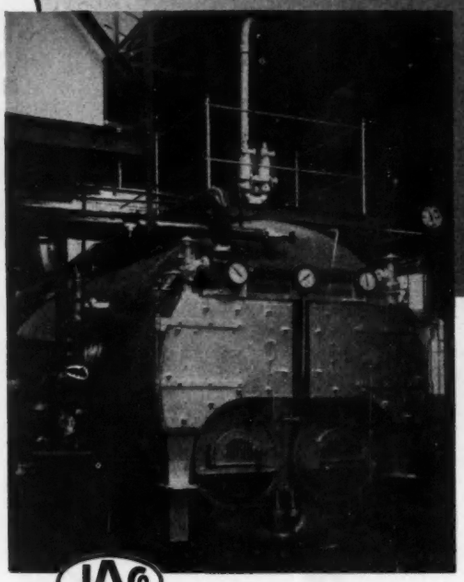
Makers:

R. BROADBENT & SON, LTD
Stalybridge

Tel. No. Stalybridge 2201/2
Tel. Address 'Broadbent Stalybridge'

JOSEPH ADAMSON

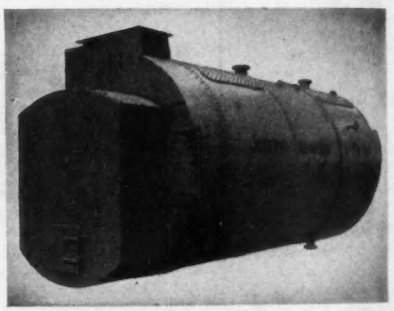
H.E. Dryback Boilers

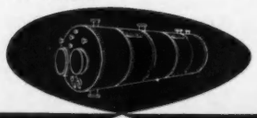


The new, revised edition of our booklet "The Choice of a Boiler" gives a concise summary of various types of shell boiler, and will be sent to responsible engineers, etc., writing on firms' letter headings.

JAC

The Joseph Adamson High Efficiency Treble Pass Dryback Boiler has several important advantages over the conventional Lancashire Boiler. It also represents a development of the Double Pass Dryback, operating efficiency being some 4% higher. The Treble Pass Dryback requires no brickwork settings and occupies only about half the floor space of a comparable Lancashire Boiler. Characteristics are quick steaming due to fairly high ratio of heating surface to water contents and a 15% reduction in water contents per hourly evaporation. The absence of horizontal baffles in the combustion chamber is a special feature of the Joseph Adamson design and overcomes the problem of flue dust accumulation against the tube-ends.





JOSEPH ADAMSON & CO. LTD.
P.O. BOX 4 HYDE · CHESHIRE

in association with

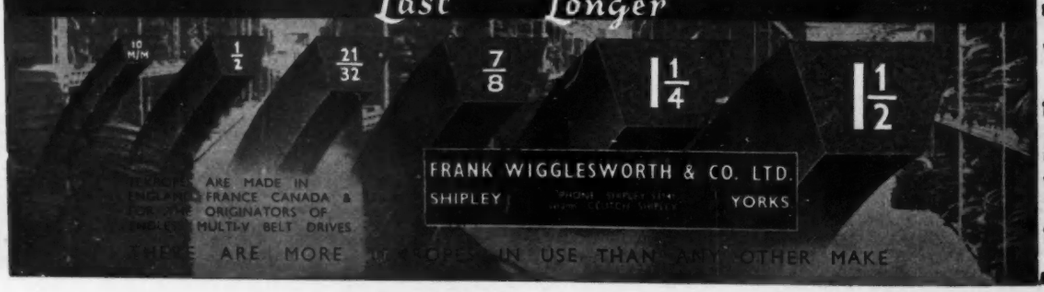
Adamson Alliance Co. Ltd., 165 Fenchurch St., London, E.C.3
Horsehay Co. Ltd., Wellington, Salop. The Alliance Machine Co., Alliance, Ohio, U.S.A

THE ADAMSON GROUP

For new drives *for Replacements*

TEXROPE V-BELTS

Last Longer



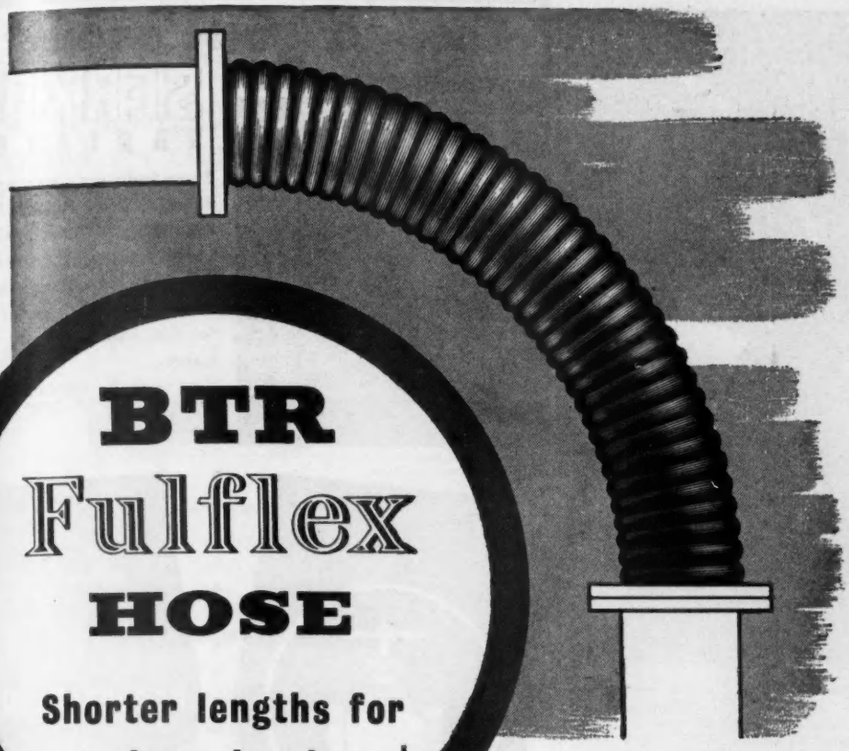
FRANK WIGGLESWORTH & CO. LTD.
SHIPLEY YORKS

ARE MADE IN FRANCE CANADA & ORIGINATORS OF MULTI-V BELT DRIVES

THERE ARE MORE IN USE THAN ANY OTHER MAKE

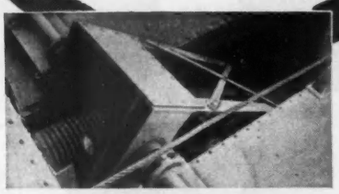
ASK FOR PRICES

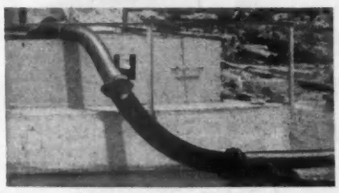
WIGGLESWORTHS
the originators and largest makers of V-belt drives in this country.



BTR Fulflex HOSE

Shorter lengths for sharp bends





BTR Fulflex Hose can be used in shorter lengths than spigoted hose for carrying gravel and sand round sharp bends in pipe lines. Because connections are made without spigots, 6 ft. of BTR Fulflex will bend through the same angle as 8 ft of spigoted hose—6 ft of 8″ bore, for example, bends through 90°.

The greater flexibility of BTR Fulflex Hose ensures greater manoeuvrability in operation; as for example, in moving to various depths of the pit. And its exceptional strength and durability mean that it far outlasts even a steel bend. For shorter lengths with longer life specify BTR Fulflex sand and gravel hose.

ENGINEERS IN RUBBER BTR

BRITISH TYRE & RUBBER CO. LTD
Herga House, Vincent Square, London S.W.1

D1100

BARRY SCREENS

BARRY, HENRY & COOK, LTD.,
ABERDEEN.

B. LEVY & CO.
(Patterns) Ltd.

Specializing in

Pattern Equipment of all kinds including the largest Wooden Patterns and intricate metal patterns for Shell Moulding

Send your enquiries to our works at:
1-5 OSBERT STREET
Vauxhall Bridge Road
London, S.W.1.
Phone : Victoria 1073 or 7486

FARRAR BOILERS

FOR ALL INDUSTRIAL PURPOSES

Including installations for
GASWORKS · HOTELS
HOSPITALS · SCHOOLS
PITHEAD BATHS
PUBLIC BUILDINGS
GRAIN SILOS Etc.

THE FARRAR BOILERWORKS
NEWARK (NOTTS) ENGLAND
Telegrams: Farrar, Newark 1143
Telephones: Newark 1143-4-5
RAISE STEAM WITH A FARRAR

Samuel Talbot
(ENGINEERS) LTD

Specialists in Fabrication of Industrial Plant

IN MILD STEEL, STAINLESS MONEL
INCONEL NICKEL AND CORRONEL B

We can handle capacities up to **20 tons**

*Plate Bending & Rolling—***8ft. x 1in.** *thick*

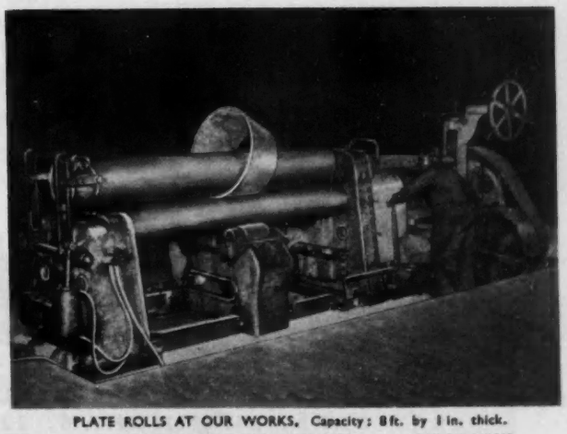
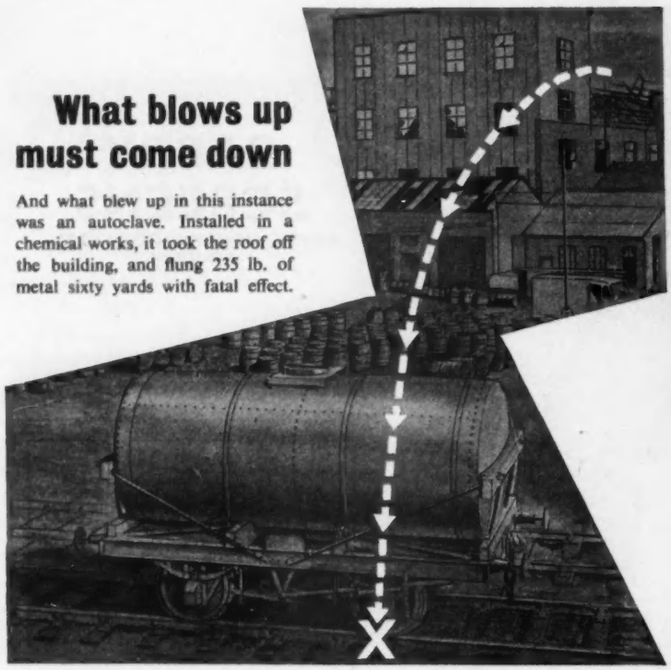


PLATE ROLLS AT OUR WORKS. Capacity: 8 ft. by 1 in. thick.

SAMUEL TALBOT ENGINEERS LTD · TEAM VALLEY TRADING ESTATE · GATESHEAD ON TYNE · ENGLAND

What blows up must come down

And what blew up in this instance was an autoclave. Installed in a chemical works, it took the roof off the building, and flung 235 lb. of metal sixty yards with fatal effect.



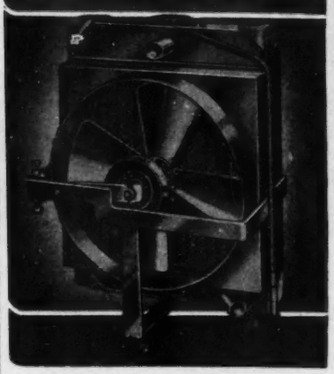
What Vulcan say about it

The foregoing proves, that danger can lurk in every kind of factory plant. Boilers, lifts, hoists, cranes—are all liable to accident. That's why regular inspection by specialist engineers is essential. Vulcan's Engineer-Surveyors are the experts. It's their job to detect the defects, to ferret out the flaws, to point out whatsoever is wrong and how to put it right. Safety first is Vulcan first.

FREE. For news of industrial accidents and ways to avoid them, ask us now for 'Vulcan'—a quarterly journal for Power Users. Please write to Dept. 19.

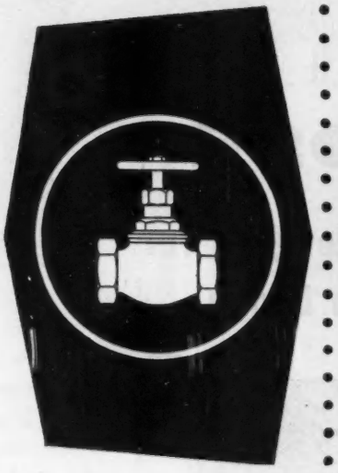
THE Vulcan
BOILER & GENERAL INSURANCE CO. LTD.
67 *King Street, Manchester* 2
Vulcan Inspects—and Protects

Cooling your engine
SERKOOL RADIATORS



These Radiators consisting of Cooling Element, Cowl, Fan and Pulley have been designed for Engines of 1 to 60 h.p. where a light, sturdy and compact unit that will stand any amount of VIBRATION, is required. Write for full particulars and descriptive leaflet.

H. O. SERCK, LTD.,
Sunlight Works, Derby St., Oxford Rd., Manchester, 13
'Phone: Ardwick 2776 (3 lines). Telegraphic Address: "SERCKRAD."

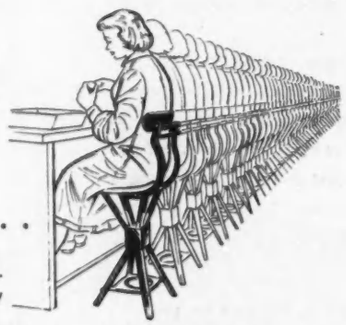


valves cocks and pipe line fittings

PEGLER & LOUDEN

54 BROWN ST GLASGOW C2
113 NEW BRIDGE ST NEWCASTLE ON TYNE

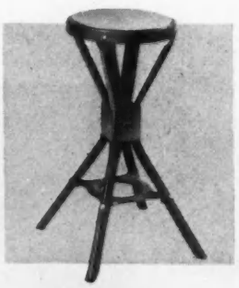
for a comfortable rise in output . . .



When workers (from the chairman downwards) sit comfortably and anatomically correctly, production, paradoxically enough, goes up. You'll find a *comfortable* rise in profits if you make your base of operations an Evertaut chair.

General Purpose Chair E54
Revolving and adjustable for height, this model is suitable for general use. Strong steel base, domed feet, shaped seat in varnished wood or strong pressed fibre to choice, swivel backrest in steel with rexine covered pad are the main features.

Operatives Stool E1
A simple stool suitable for certain operations and occasional use. Obtainable with steel legs, domed feet, 12in. diameter circular seat in varnished plywood and height varying from 17in. to 27in. as required.

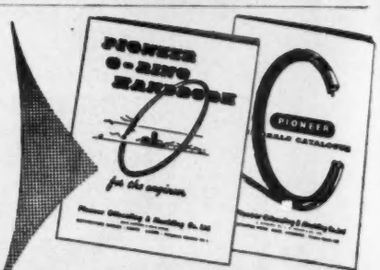


get down to it with EVERTAUT LIMITED

Send for full details of all Evertaut office and industrial seating.

EVERTAUT LTD. (Dept. T8), WALSALL ROAD
PERRY BARR, BIRMINGHAM, 22B
Telephone: BIRchfields 4587 (4 lines) *Telegrams:* "Evertaut, Birmingham"

Two important publications on fluid sealing FREE!



Pioneer O-Ring Handbook. A comprehensive work containing a mine of information on oil sealing problems.

Pioneer Oil Seals Catalogue—Data is in handy indexed form and fully illustrated for the use of engineers and designers.

PIONEER OIL SEALS PLEASE

PIONEER OILSEALING & MOULDING CO. LTD.
Factory and Head Office: Cottontree Works, Colne, Lancs. Tel: Wycoller 4112

Were losing our grip SAID THE NUT TO THE BOLT

Forget about vibration and slackness—fit a Kolok Positive Lock Washer between each nut and bolt.

We need a KOLOK *Positive Lock Washer*

POSITIVE LOCK WASHER CO. LTD., 35 RENFREW STREET, GLASGOW
Telephone: DOUglas 9292

PRIOR for SMOKELESS COMBUSTION EFFICIENCY and countrywide service

PRIOR UNDERFEED STOKER Hopper and "Bunker Flow" models are available for heat outputs of from 100,000 to 16,000,000 B.T.U.'s per hour and they include the patent "Duplex" retort type.

The PRIOR policy is two-fold — to produce the best mechanical firing equipment for oil and coal and to provide the finest service for it. The entire range of PRIOR oil burners has recently been redesigned to incorporate the most modern practice. PRIOR underfeed stokers have been progressively improved so that they also function trouble free at the highest thermal efficiency. The PRIOR technical organisation covers the country and is backed by four separate area servicing centres each at a place of importance.

MANUFACTURERS OF OIL BURNERS AND UNDERFEED STOKERS

PRIOR STOKERS LIMITED

1/3 BRANDON ROAD, LONDON, N.7.
Telephone: NORTH 2245/8

50 WELLINGTON ST., GLASGOW, C.2.
Telephone: CENtral 5323/4

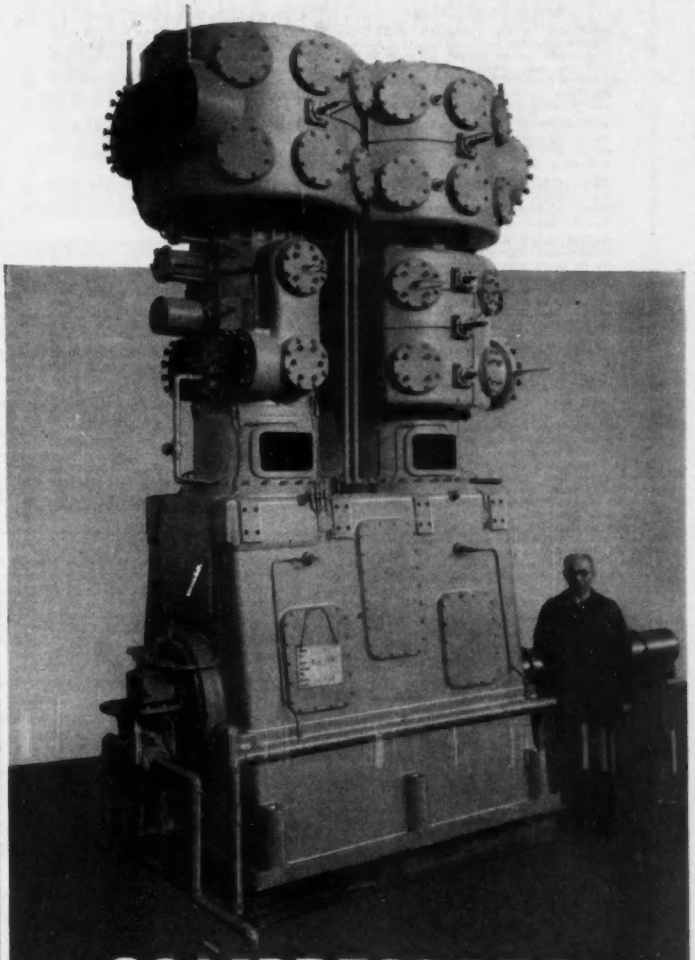
And at BIRMINGHAM · BRISTOL · CARDIFF · LEEDS MANCHESTER · NEWCASTLE · NOTTINGHAM

The last word in ropeway design

An Aerial Ropeway may be the answer to your transportation problems.

Write for illustrated brochure.

BRITISH ROPEWAY ENGINEERING CO. LTD.
PLANTATION HOUSE,
MINCING LANE, LONDON, E.C.3.
Telephone: MINcing Lane 7901
Telegraphic Address: Bozhauling, Fen, London.



COMPRESSORS *for* INDUSTRIAL GASES

Moderate speed compressors carefully designed for reliability, are available in both vertical and horizontal form from small units up to units of over 5000 h.p. and very high pressures.

Illustrated is a vertical twin crank three stage compressor with a capacity of 6000 cubic metres per hour at 290 r.p.m. and a delivery pressure of 20 atmospheres.

Lloyd & Ross Ltd
58, Victoria Street, S.W.1. Telephone: Vic 4873

Maschinenfabrik Esslingen Germany

Classified Advertisements continued from Page 7

BRITISH CELLOPHANE LIMITED, BRIDGWATER, SOMERSET, seeks

SENIOR AND JUNIOR DRAUGHTSMEN, for both **PERMANENT** and **TEMPORARY** appointments, for work on machine design and chemical plant layout. Applicants should possess at least O.N.C. and have had three years' shop experience. Five-day week. Pensions Fund Scheme for permanent appointments. Ref. No. E56.Eg. **THE TEMPORARY** appointments are for a period of approximately two years' duration, subject to three months' notice and include generous subsistence allowances, and periodic home return rail fares.

ASSISTANT ENGINEER, AGE 23/30 (PERMANENT.) Applicants should have an honours degree in mechanical engineering and have had some practical works experience. The duties will be on development, improvement and maintenance of chemical and other plant. Ref. No. E57.Eg.

SECTION LEADER DRAUGHTSMAN (PERMANENT) in connection with the design of factory services. Applicants should possess H.N.C., have had at least three years' shop experience, and be familiar with all types of pipework installations. Ref. No. E58.Eg.

ASSISTANT ENGINEER, AGE 25/30 (PERMANENT.) Applicants should have a university degree and have works experience, or be an A.M.I.Mech.E. The duties will be on development, improvement and maintenance of plastic films extrusion plant and ancillary equipment. Ref. No. R48.Eg.

Write to the Personnel Officer, stating full particulars and salary required, and quote Ref. Nos. as indicated. L 970

BRUSH ELECTRICAL ENGINEERING CO., LTD., have vacancies for men of ambition seeking progressive and responsible positions as

TENDERING AND CONTRACTS ENGINEERS in their Commercial Departments at Loughborough. Applicants should be capable correspondents with experience in one or more of the following: turbo-alternators, rotating machines, switchgear or transformers. Additionally, vacancies exist in the General Engineering Division for men having specialised knowledge of comprehensive power schemes for both diesel and steam generating stations. Appointments will be of a permanent nature with good salaries, and excellent prospects are open to suitable men. Conditions of service include non-contributory staff assurance.—Please write with full details in confidence to the CHIEF PERSONNEL OFFICER, BRUSH ELECTRICAL ENGINEERING CO., LTD., LOUGHBOROUGH, LEICS. L 764

DRAUGHTSMEN (SENIOR AND JUNIOR) required for work in connection with the following branches of Coke Oven and Gasworks plants.

(*a*) Mechanical and By-Product Plant.
(*b*) Pipework.
(*c*) Steelwork for Buildings and Conveyors.

Applicants should be competent men able to work with the minimum of supervision. Technical qualifications to O.N.C. or beyond. Good remuneration and prospects for capable men. Pension scheme. Five-day week; Canteen Facilities.—State age and experience to the PERSONNEL OFFICER (D.O.), WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD., WOODALL-DUCKHAM HOUSE, 63-77, BROMPTON ROAD, LONDON, S.W.3. G 550

SENIOR ENGINEER, a vacancy exists for a Senior Engineer on the Permanent staff at a large sugar refinery. Experience in charge of mechanical engineering maintenance is essential and it would be an advantage to have experience of operation and maintenance of steam and power generating plant. Applicants, who must be medically fit and aged not more than 40, and who should be either A.M.I.Mech.E. or equivalent standard, should apply in writing giving details of their career to the CHIEF ENGINEER, TATE & LYLE, LIMITED, LOVE LANE SUGAR REFINERY, LIVERPOOL, 3. L 869

ESTIMATOR (SENIOR) required by Steel Pipe Manufacturing Firm in S.W. England. Progressive position. Pension scheme. Salary, £800-£1000 p.a. —BOX L 797, Offices of ENGINEERING.

DRAUGHTSMAN required for Engine Design Schemes on small high-speed diesels must have initiative and experience. Good salary. Pleasant working conditions. Pension Scheme.—Apply CHIEF PERSONNEL OFFICER, PETTERS LIMITED, CAUSEWAY WORKS, STAINES. G 650

LEADING MANAGEMENT CONSULTANTS with interests throughout the British Isles and Commonwealth requires the services of qualified and experienced

ENGINEERS AND ACCOUNTANTS.

Applicants willing to accept assignments for a limited initial period of three to five years in Canada, Africa or New Zealand are invited to apply. Age not over 40. Remuneration on a high scale with superannuation and expense allowances.—Full details of qualifications and experience to the PERSONNEL MANAGER, BOX L 736, Offices of ENGINEERING.

STRUCTURAL ENGINEER required by London firm of Consultants to take charge of their steel design office. Candidates must have a comprehensive knowledge of all types of structural steelwork both designing and detailing and should preferably have had some works experience. Applicants should be Corporate Members of one of the senior professional Institutions or hold similar Degrees. The post is a permanent one and there is a Staff Pension Scheme.—Please reply in confidence to BOX NO. 389, GLOVERS ADVERTISING, LTD., 351, OXFORD STREET, W.1. G 648

ASSISTANT METALLURGIST required for Commercial Motor Vehicle Manufacturers. Candidates must be experienced in metallography and production heat treatment of steels. Applications, in writing, giving details of qualifications, experience and salary required, to A.E.C. LIMITED, STAFF RECORDS OFFICE, WINDMILL LANE, SOUTHALL, MIDDX. L 926

Large Electrical Cable Manufacturers, N. London, require

PLANT LAYOUT ENGINEER. Applicants must be fit and have considerable experience of layout of plant and all services. Previous cable factories experience desirable but not essential.—Write full details, past experience, salary required and availability to Chief Works Engineer, BOX L 941, Offices of ENGINEERING.

DEVELOPMENT ENGINEER; a vacancy exists for a Development Engineer at a large Sugar Refinery. The duties involve investigation of technical problems both practical and theoretical, production of technical specifications for new plant, commissioning and testing plant, under the general control of the Development Engineer. Candidates must have a good general education and University Degree in Mechanical (or Chemical) Engineering, and be under 35 years of age.—Applicants should write giving details of their career to the CHIEF ENGINEER, TATE & LYLE LIMITED, LOVE LANE SUGAR REFINERY, LIVERPOOL, 3. L 868

DRAUGHTSMAN required with some experience of Shell Type Boilers and Boiler Installation. Country district, salmon and trout fishing in River Annan. Powfoot Golf Course two miles away. Apply, stating age, experience and salary required, to:—COCHRAN & CO., ANNAN, LTD., ANNAN, DUMFRIESSHIRE, SCOTLAND. L 840

SENIOR JIG AND TOOL DRAUGHTSMEN required for Tool Design on

(*a*) Small I.C. Engine components.
(*b*) Fuel Injection and Hydraulic Control Mechanisms on a production basis.

Applicants should have experience in these or similar fields.

Pleasant working conditions. Generous salary commensurate with qualifications demanded. Attractive pension scheme. Comprehensive welfare facilities.

Apply to CHIEF PERSONNEL OFFICER, BRYCE BERGER WORKS, STAINES, MIDDX. G 660

SITE ENGINEERS

required by
BRITISH OXYGEN ENGINEERING LIMITED,
Angel Road, Edmonton, N.18.
(Tel.: EDMonton 3020.)

Vacancies exist for two qualified engineers between the ages of 30 and 40 years who are accustomed to handling large-scale installations of chemical plants involving H.P. gas systems and heavy reciprocating machinery. Considerable experience of site organisation and administration is essential and applicants must be capable of taking entire responsibility on site.

The Company offers excellent salaries and conditions of service.

Applications in writing to the Staff Officer stating full details of age, experience and salary required. L 947

SHEEPBRIDGE ENGINEERING LIMITED, CHESTERFIELD, offer attractive opportunities for

SENIOR DESIGNERS

capable of upgrading to project work; experienced in Material Handling Plant for Quarries and Collieries. Applications from Designers and Draughtsmen with qualifications in General Engineering will also be given consideration for duties of a suitable nature. Progressive superannuated positions, attractive salaries commensurate with qualifications and experience, with provision of houses for senior positions if required.—Apply, giving details of qualifications, experience, etc., and quoting reference EQD, to the PERSONNEL MANAGER. L 935

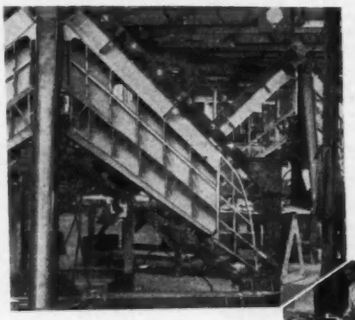
DESIGN ENGINEER.

COURTAULDS LIMITED requires a **DESIGN ENGINEER** at its Engineering Headquarters in Coventry for development work on man-made fibre-making plant and machinery. A good engineering degree is essential, and several year's industrial experience in the design and development of chemical, textile, or allied process plant and machinery is desirable. Age 27 to 40. Applicants should have an aptitude for solving design problems and calculations in this type of engineering.

Candidates should write giving full personal particulars and details of experience to the DIRECTOR OF PERSONNEL, COURTAULDS LIMITED, 16, ST. MARTINS-LE-GRAND, LONDON, E.C.1, quoting reference number B.36. L 925

SHEET METAL ENGINEERING...

for the **AIRCRAFT INDUSTRY**



★ Our photographs show sections of nor extensive works where work is in progress on complete tailplane assemblies for the famous Hawker Hunter jet fighter aircraft.

★ Our long experience and modern equipment, coupled with our high quality and precision workmanship, enable us to offer a specialised service to the aircraft industry. We can make prototype components or equipment and can also produce the tools to do the job. Our spacious workshops can also handle quantity production.

Full information available from Dept E.1/56

E.G. Brown & Co. Ltd

WEST ROAD, TOTTENHAM, LONDON, N.17.

Here is the perfect jointing for high pressure smooth surface or screw unions!

Tested and recommended by the Ministry of Supply (MTV Branch) Reference No. VG.6/300/FIR for export to tropical countries

OSOTITE—the modern scientific sealing which has been proved by rigorous tests to be the perfect jointing for smooth surface and screw unions. OSOTITE is a simply applied liquid compound, impervious to heat, petrol, oil, grease, water and steam, which ensures in a few minutes a HIGH PRESSURE GAS AIR or WATER-TIGHT JOINT.

OSOTITE

A SLICK PRODUCT

Write for full details and prices to:—

SLICK BRANDS LTD
STAFFORD ROAD, WADDON, CROYDON, ENGLAND
Tel: CROYDON 3171-2 Cables: SLICKBRA, SOUPHONE, LONDON

MECHANICAL ENGINEERS

A large and well-known Company in the North of England offers the following attractive working conditions:—

1. Starting salaries up to £1300 p.a.
2. An Engineering career with outstanding opportunities in an expanding industry.
3. An opportunity for the young engineer to obtain varied experience in Research, Design, Construction, Maintenance, Work Study.
4. Post-graduate training when necessary with full staff salary.
5. Specialist appointments in the Research field for those suitably qualified.
6. A congenial working atmosphere and unexcelled welfare facilities.
7. A job in an area comparing favourably with any in England.

If you have a University degree or a professional qualification, we shall be pleased to hear from you. Whilst we prefer men in their twenties, we have a number of vacancies suitable for experienced men up to 35 years of age.

Write, giving a brief summary of your qualifications and experience, to BOX L 808, Offices of ENGINEERING, quoting reference P.6.

Designers & Draughtsmen required by BRITISH OXYGEN ENGINEERING LIMITED at EDMONTON and HARLOW

★ *The work of the Company covers a wide and interesting field including*

(*a*) **The design, layout and installation of large-scale chemical plants, and**

(*b*) **the design of special purpose machines and equipment for the application of cutting and welding techniques.**

★

Vacancies exist for Designers and Draughtsmen with experience in any of the following fields:

CHEMICAL PLANT DESIGN Including pressure vessels, compressors, heat interchangers, etc.

PLANT LAYOUT and INSTALLATION including general factory services, pipework, etc.

SPECIAL PURPOSE MACHINES · GENERAL MECHANICAL ENGINEERING CIVIL AND STRUCTURAL · ARCHITECTURAL · JIG AND TOOL DESIGN

★

The Company offers excellent salaries and conditions of service:

AT HARLOW, RENTED ACCOMMODATION IS AVAILABLE AND REMOVAL EXPENSES ARE PAID.

AT EDMONTON, HOUSE PURCHASE FACILITIES ARE AVAILABLE AND REMOVAL AND LEGAL EXPENSES ARE PAID

★

Applications, giving full details of experience, qualifications and salary required, to the Staff Officer, British Oxygen Engineering Ltd., Angel Road, Edmonton, N.18 L 909

An opportunity occurs with a Bedfordshire Firm making small articles by mass production methods for a

MAN, AGED APPROXIMATELY 30-40, who is proficient and experienced in general engineering workshop practice, and also capable of a certain amount of design work. Initially he will be assigned to assist senior technical staff responsible for the running of mechanized Production lines, but eventually, if suitable, he will be expected to take charge of the factory workshop, engaged in machine maintenance, machine building, and development work. A good salary will be paid.—BOX L 815, Offices of ENGINEERING.

DEVELOPMENT ENGINEER. Experienced in modern machine press and plastic techniques, required for the development of anti-vibration and lock nuts. Salary commensurate with qualifications and experience is offered. Applicants are invited to send full details of age, training and experience to the PERSONNEL MANAGER, SIMMONDS AEROCESSORIES LTD., TREFOREST INDUSTRIAL ESTATE, PONTYPRIDD, GLAMORGAN. L 825

ASSISTANT WORKS ENGINEER required by industrial concern in West Midlands. Age 26-35. Engineering degree and industrial experience essential. Duties include supervision over maintenance and construction of wide range of plant and buildings. Salary according to qualifications and experience. Pension scheme. Housing Assistance if required.—BOX L 805, Offices of ENGINEERING.

WANTED

DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to NORTHERN ALUMINIUM CO., LTD., BUSH HOUSE, ALDWYCH, LONDON, W.C.2. G 562

SENIOR DRAUGHTSMAN required, London area. Heavy Mechanical Engineering experience essential, knowledge of gearing an advantage.—Write stating age and salary required and giving full details of experience to THE SECRETARY, THE POWER PLANT COMPANY, LIMITED, WEST DRAYTON, MIDDLESEX. Property for rental would be made available to suitable applicant. L 681

Marine Engineering Company constructing main steam turbines and diesel machinery, watertube boilers, etc., for largest sizes of warships, passenger ships and oil tankers requires a

GENERAL MANAGER to supervise the Works and to be responsible for production to the Managing Director.—Applicants please state age, qualifications, experience and an indication of salary required to BOX L 715, Offices of ENGINEERING.

ESTIMATOR required, London area. Heavy Mechanical Engineering experience and knowledge of gearing essential.—Write giving full details of experience, salary required and age to: THE SECRETARY, THE POWER PLANT COMPANY, LIMITED, WEST DRAYTON, MIDDLESEX. Property for rental would be made available to suitable applicant. L 680

Several fully experienced

DESIGNER-DRAUGHTSMEN are required for the London office of a leading firm of boilermakers, engaged in the design of large steam generator contracts. Salaries up to £1250 per annum will be paid to top-quality men. Pension Scheme, 5-day week.—Reply in confidence, giving details of experience and qualifications to BOX L 854, Offices of ENGINEERING.

A TECHNICAL ASSISTANT (DIESEL) required to work under direction of the Chief Mechanical and Electrical Engineer in the development and follow through to inspection and Type testing of main line diesel electric locomotives being purchased by the British Transport Commission under the Modernisation Plan. A sound working knowledge of diesel engines and of electrical generation, transmission and supply to auxiliaries as applied to locomotives, essential. Technical qualifications, Engineering degree or A.M.I.Mech.E. or A.M.I.E.E. desirable. Experience in office procedure and conducting technical correspondence an advantage.—Applications should be submitted to the CHIEF MECHANICAL AND ELECTRICAL ENGINEER, EASTERN AND NORTH EASTERN REGIONS, BRITISH RAILWAYS, DONCASTER. L 814

PLANT LAYOUT DRAUGHTSMEN required urgently by large Cable Manufacturers, N. London. Applicants must be fit and previous experience in cable factories an advantage. Full apprenticeship and H.N.C. desirable but not essential.—Apply in writing giving full details, past experience, salary required and availability to Chief Works Engineer, BOX L 940, Offices of ENGINEERING.

Leading manufacturers of container closures in the Midlands have a numbes of vacancies for ambitious **DESIGN DRAUGHTSMEN** preferably with some experience in this or a similar sphere. Interesting work with excellent salary and every opportunity for promotion to senior position in a rapidly growing organisation. Write in confidence with details of experience, positions held, salary required, to P.A. METAL CLOSURES LIMITED, BROMFORD LANE, WEST BROMWICH. G 627

Vickers-Armstrongs (Aircraft) Limited, Weybridge, Surrey

require

(o) AIRCRAFT SPARES SCHEDULE COMPILERS

(at Weybridge and Hurn)—suitable ex-R.A.F. personnel required or civilians with airframe maintenance experience.

(p) ESTIMATORS (Senior)

for general aircraft work.

Applications, quoting date and prefix letter of advertisement to: EMPLOYMENT MANAGER, VICKERS - ARMSTRONGS (AIRCRAFT) LIMITED, WEYBRIDGE WORKS, WEYBRIDGE, SURREY. L 971

SENIOR DESIGNER-DRAUGHTSMAN required by engineering company in Enfield manufacturing paper converting mchinery. An interesting and responsible position is available to a man with modern design ability.—BOX L 888, Offices of ENGINEERING

Excellent Opportunities For MECHANICAL & ELECTRICAL ENGINEERS *in the United States of America*

Hughes, one of America's leaders in the field of advanced electronics has openings for Mechanical and Electrical Engineers. These Engineers must have degrees and six or more years' experience in developing servo-mechanisms and/or electronic controls. Hughes, located on the West Coast of the U.S.A., offers Engineers opportunity, challenge, and reward.

London and Manchester interviews in June.

For interview, air mail resume to

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT CO., 5440 W. CENTURY BOULEVARD, LOS ANGELES 45, CALIFORNIA, U.S.A. ATTENTION: M. MAY.

L 777

PRODUCTION ENGINEER required for Senior Appointment with Leading Motor Car Manufacturers, to be responsible for controlling Production Planning, Machine Tool Specification, Jig, Tool and Gauge Design, and Plant Layout.

Applicants must prove a successful record in a similar capacity, and should not be over 45 years of age. Only those with experience of Modern Machine Techniques, Assembly and Layout, and of managing a large staff need apply.

The position is superannuated, carries substantial remuneration, and presents first-class opportunities for advancement.

Applications will be treated in strict confidence, should contain full particulars, and be addressed to BOX B6.296, c/o 191, GRESHAM HOUSE, E.C.2.

L 859

A Firm of Heavy Vehicle Manufacturers in the South of England require a

MACHINE SHOP SUPERINTENDENT

capable of taking charge of more than 800 machines. This is a senior position of responsibility and will be remunerated accordingly. Pension Scheme in operation.—BOX L 803, Offices of ENGINEERING.

GOSS PRINTING PRESS COMPANY LIMITED have immediate vacancies for:—

RATEFIXERS.

PROCESS PLANNING ENGINEERS.

Applicants should have served a recognised engineering apprenticeship and have practical experience in the appropriate branch of light and medium precision engineering. These are permanent positions with a generous superannuation scheme and a bonus is paid annually. Salary in accordance with experience and ability. Please supply full details of age, experience and qualifications to PERSONNEL MANAGER, GREENBANK STREET, PRESTON.

L 965

IMPERIAL CHEMICAL INDUSTRIES LIMITED
METALS DIVISION

Applications are invited for the position of

OPERATIONS MANAGER

at the

WAUNARLWYDD WORKS, NEAR SWANSEA.

The Waunarlwydd factory, which is pleasantly situated some 4 miles to the North West of Swansea, requires an **OPERATIONS MANAGER** for the Aluminium Sheet, Strip and Extrusion plants of the Division.

This should be regarded as a senior position carrying a commensurate salary, and will only be offered to a man of outstanding ability.

These plants are in the process of an extensive modernisation which is nearing completion. The Operations Manager will be expected to develop the full potentialities of these plants in collaboration with other Departments, e.g., Commercial, Technical and Engineering.

The successful applicant will be directly responsible to the Works Manager for all personnel and manufacturing operations, including casting, connected with sheet, strip, extrusion and wire manufacture.

The Company operates a Contributory Pension Fund and a Profit Sharing Scheme. The successful candidate will be granted a contribution towards removal (including travel) expenses, and, if necessary, financial help is available to assist in house purchase.

Applications should be addressed to the STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting W'dd/1/ENG. L 946

Classified Advertisements continued on Page 108

KELLOGG

INTERNATIONAL CORPORATION

Design and Construction Engineers of world-wide repute in the petroleum and chemical industries invites applications from junior and senior graduate chemical and/or mechanical engineers

as

PROCESS PIPING ENGINEERS.

The work consists of the preparation of piping flow diagrams both for process and utility systems. Engineers in these positions will work intimately with the process design of refinery and chemical plants and handle problems of instrumentation, pumping, gas compression, heat exchange and other unit operations. A formal training programme is arranged for new employees.

The Corporation offers comprehensive employee benefits which include:

CONTRIBUTORY PENSION SCHEME.
NON-CONTRIBUTORY LIFE INSURANCE.
GENEROUS SICK BENEFIT SCHEME.
FULL INSURANCE COVER FOR DUTY JOURNEYS.
HOUSE PURCHASE ASSISTANCE SCHEME.
GENEROUS OVERTIME PAYMENTS.
LUNCHEON VOUCHERS.
ETC.

THOSE WHO KNOW OUR NAME KNOW WE PAY WELL.

Write now to
PERSONNEL MANAGER,
Dept. 66/H,
KELLOG INTERNATIONAL CORPORATION,
7-8, Chandos Street,
London, W.1.

Holiday arrangements will be honoured. Interviews can be arranged to suit applicants by prior appointment by telephoning MUSeum 4010.

L 898

IMPERIAL SMELTING CORPORATION LIMITED requires an **ASSISTANT AREA ENGINEER** to take responsibility for the maintenance of the Roasting Plants at the Avonmouth Works. Candidates must have a qualification equivalent to at least Grad.I.Mech.E. standard and must have experience in the field of heavy engineering including the supervision of labour.—Write for application form to PERSONNEL MANAGER, IMPERIAL SMELTING CORPORATION, LTD., AVONMOUTH, BRISTOL, giving brief details of age, qualifications and experience and quoting reference: DSL/EG. L 978

Heavy Engineers in the Trafford Park Area require **A WELDING SUPERVISOR** who must be experienced in gas and electric welding. Also familiar with argon and submerged arc processes. Experience of flash and spot welding desirable. Some metallurgical knowledge essential. This is a superannuable position with excellent prospects. Applicants must give full particulars and mark applications for the attention of the PERSONNEL MANAGER.—BOX L 976, Offices of ENGINEERING.

FAIRBAIRN LAWSON COMBE BARBOUR LIMITED,
WELLINGTON FOUNDRY,
LEEDS, 1.

WORKS MANAGER required by above Company which manufactures textile and other light machinery, light and medium machine tools and general engineering products.

Applicants must be of a high calibre having a successful record of achievement in a similar position with up to date knowledge of shop floor practice and capable of instructing shop supervision to obtain maximum efficiency.

Apply, in confidence, with particulars of education, training, experience and positions held with dates and responsibilities covered. Applications should be marked "Private and Confidential" and addressed to "The Secretary."

The position advertised arises from impending retirement and carries a substantial salary.

L 959

WORKS MANAGER required by a well established heavy general engineering company with an international reputation in the manufacture of mining plant, water turbines and special engineering projects. Applicant must have first-class technical qualifications and proven administrative ability backed by a wide practical experience of manufacturing methods and jig and tool design associated with this type of production. In addition, applicants must be able to deal with all matters related to production control. An appropriate salary with superannuation will be paid.—Applications with full details, which will be dealt with in strict confidence, should be addressed to BOX 209, R. ANDERSON AND CO., 14, WILLIAM IV STREET, LONDON, W.C.2. L 876

DRAUGHTSMAN required for detail work in connection with the design of equipment and instruments for a comprehensive range of experiments in the research laboratories of British Insulated Callender's Cables Limited, 38, Wood Lane, W.12. Candidates should be in the age range 25/30. The position would lead to permanency and is pensionable after a qualifying probationary period.—Applications giving details of age, qualifications and experience to STAFF OFFICER, B.I.C.C. LIMITED, 21, BLOOMSBURY STREET, LONDON, W.C.1. Reference L/29/56. L 938

BRITISH OXYGEN GASES, LTD., require the services of a

JUNIOR ELECTRICAL DRAUGHTSMAN for work in connection with electrical circuits for power and lighting installations and plant layout in factories. No actual experience of this work is necessary but candidates must have the ability to develop and acquire experience in this field.—Write stating full particulars to PERSONNEL MANAGER, BRIDGEWATER HOUSE, CLEVELAND ROW, ST. JAMES'S, S.W.1. L 933

YOUNG ENGINEER OR CHEMICAL ENGINEER required for project work on drying plant for air and other industrial gases to meet new applications and conditions. The work involves development of designs and layouts together with the necessary calculations. Previous process plant experience is desirable. This position calls for intelligence and hard work and is an important one in the continued expansion of this division.—Apply in writing to PERSONNEL MANAGER (DRYER DIVISION), BIRLEC LIMITED, TYBURN ROAD, BIRMINGHAM, 24. L 886

SENIOR DEVELOPMENT ENGINEERS for the design and development of mechanical and electrical components for Power Cables of all voltages; for Telecommunication Cables and Overhead Current systems for electric traction. Candidates should be qualified to degree standard and preferably have had some production experience.

SENIOR DESIGN ENGINEERS for the design of new and original accessories for Low, Medium and High Voltage Power Cables. Higher National Certificate or equivalent qualification is desirable, and production experience essential.

Applications quoting reference P/39/56 should be submitted to the STAFF OFFICER, B.I.C.C. LTD., PRESCOT, LANCS. L 923

FUEL ENGINEERING ASSISTANT for a large group of companies. Able to undertake efficiency surveys of whole factories including high temperature furnaces, steam boilers, space heating equipment and the like. Age about 30. Pension Scheme.—State qualifications, experience and salary required to PERSONNEL MANAGER, TUBE INVESTMENTS (GROUP SERVICES) LIMITED, ROCKY LANE, ASTON, BIRMINGHAM, 6. L 897

CIVIL ENGINEERS, CANADA.

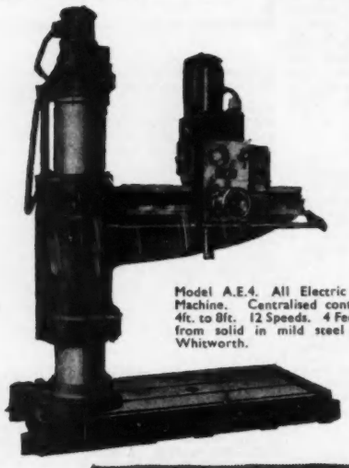
Expanding Consulting Engineers, Headquarters Toronto, large works in prestressed and reinforced concrete, require following staff: Project Engineers, to organise design team and take complete charge of a project: salary $500 per month and upwards. Assistant Engineers, to act as immediate deputy to project Engineer: Salary $400 to $500 per month. Cost of passage advanced to Engineers engaged, 50 per cent. of cost cancelled after 6 months service, balance of cost cancelled after 12 months service.—BOX L 958, Offices of ENGINEERING.

DESIGN ENGINEER required for selector and transfer mechanisms; hopper feeds; folding, wrapping and printing mechanism; automatic sequences of mechanisms. Excellent scope and conditions for candidates interested and experienced in this branch of engineering.—RHODEN PARTNERS, LTD., 51, NORTH ROW, W.1. MAYfair 6248. L 879

CHIEF DESIGNER required to undertake control of design activities associated with heavy engineering projects of a highly specialised nature including water turbines and mining plant and equipment. Technical qualifications of the highest order are essential plus a record of proven administrative ability and capacity for conducting technical negotiation, together with solid practical experience of research, design and production. The Company seeking to fill this position is among the leaders of its field and has an international reputation of high standing. An appropriate salary with superannuation will be paid. Present staff are aware of this advertisement. Application with full details of age, education, qualifications, experience, etc., to BOX 215, R. ANDERSON & CO., 14, WILLIAM IV STREET, LONDON, W.C.2. L 877

TECHNICAL SALES ASSISTANT required for High Voltage Insulator Sales Office. Higher National standard preferred but Ordinary National standard would be considered. Previous experience in handling correspondence or estimating would be an advantage.

Replies stating age, qualifications and experience should be addressed to the PERSONNEL OFFICER (STAFF), PILKINGTON BROTHERS, LIMITED, ST. HELENS, LANCASHIRE. L 907



Model A.E.4. All Electric Radial Drilling Machine. Centralised control. Six sizes, 4ft. to 8ft. 12 Speeds. 4 Feeds. Drills 2¼in. from solid in mild steel and taps 1¼in. Whitworth.

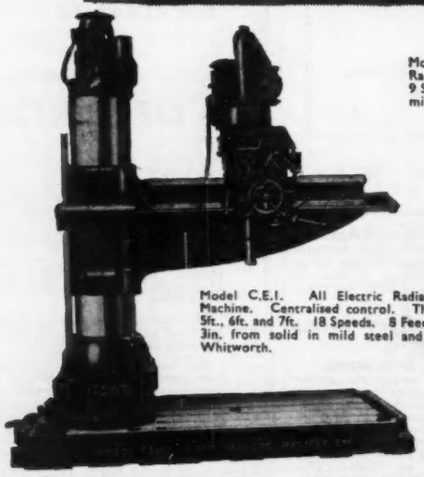
Models E.G.4 and E.G.8. All Electric Girder Type Radial Drilling Machines. Centralised control. Each model made in five sizes from 4ft. to 8ft. E.G.4: 4 Speeds. 4 Feeds. E.G.8: 8 Speeds. Range 20-500 r.p.m. 4 Feeds. Drills 2in. from solid in mild steel.

TOWN

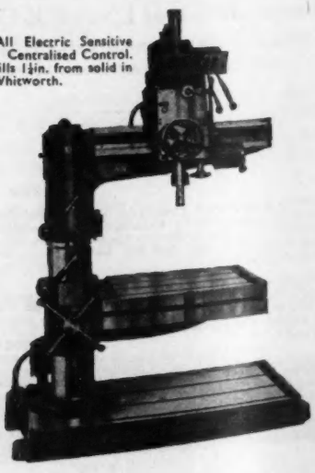
The "Town" range of drilling machines has developed from more the 50 years' experience. Town's are well known by satisfied users all over the world.

FREDK. TOWN & SONS LTD
HALIFAX - YORKSHIRE

Model A.E.2. All Electric Heavy Duty Vertical Drilling Machine. Centralised control. Two sizes: 36in. and 42in. 18 Speeds. 8 Feeds. Drills 3¼in. from solid in mild steel.



Model C.E.1. All Electric Radial Drilling Machine. Centralised control. Three sizes: 5ft., 6ft. and 7ft. 18 Speeds. 8 Feeds. Drills 3in. from solid in mild steel and taps 2in. Whitworth.



Model A.E.5. 42in. All Electric Sensitive Radial Drilling Machine. Centralised Control. 9 Speeds. 3 Feeds. Drills 1¾in. from solid in mild steel and taps ¾in. Whitworth.

ESTIMATOR AND RATEFIXER

required for Toolroom in a well-established engineering organisation engaged on large quantity production in the Automobile Industry. Applicants must have had a sound engineering training and be fully conversant with the production and maintenance of jigs, tools, fixtures and special equipment, and in particular with the application of effective bonus schemes in regard to Toolroom production. Excellent conditions; Good remuneration; Pension Scheme.

Housing accommodation available in the New Town for successful applicant.

Write in the first instance to
LABOUR MANAGER,
ALFORD & ALDER (ENGINEERS) LTD.,
MAYLANDS AVENUE, HEMEL HEMPSTEAD. HERTS. L 828

DRAUGHTSMEN
required
for design of dies and equipment and production development of techniques in Investment Casting Department. Exceptional opportunity for experience and advancement in new process work. Should have Higher National Certificate in mechanical engineering and preferably experience in precision casting or alternatively, in mould design for die-casting or plastic moulding.—Write details of training, technical qualifications and experience to PERSONNEL MANAGER, THE FAIREY AVIATION CO., LTD., HAYES, MIDDLESEX. L 916

RESEARCH ASSISTANT. Male Assistant, 25-35 years, is required for research into problems associated with fuel injection for diesel engines. Research experience plus knowledge of Fuel Injection is desirable, but some training will be given. Good general education and H.N.C. (Mech.) an advantage. Applicants should be capable of section leading after reasonable period.—Apply in writing giving full details: PERSONNEL OFFICER, SIMMS MOTOR UNITS, LTD., OAK LANE, E. FINCHLEY, N.2. L 917

DESIGNER DRAUGHTSMAN for very interesting development work on modernisation of plant in a Weldless Steel Tube Works required. This is a senior position and experience of general engineering work is necessary. Permanent position and substantial salary for suitable man. Pension Scheme.—Apply giving particulars of qualifications, experience and present salary to PERSONNEL MANAGER, TUBES LIMITED, ROCKY LANE, ASTON, BIRMINGHAM, 6. L 920

SKILLED PLANNING ENGINEERS.
The above are required by a large Engineering firm (Newcastle-upon-Tyne). Applicants must be experienced in general engineering, modern machine tooling methods and job production. Give fullest details of age, experience, etc.—Write BOX L 901, Offices of ENGINEERING.

GOSS PRINTING PRESS COMPANY, LIMITED have an immediate vacancy for :—
JIG AND TOOL DRAUGHTSMAN.
Applicants should have served a recognised engineering apprenticeship and have Drawing Office experience in light and medium precision engineering; should hold National Certificate. Permanent position with generous superannuation scheme, bonus is paid annually. Salary in accordance with experience and ability. Please supply full details of age, experience and qualifications to PERSONNEL MANAGER, GREENBANK STREET, PRESTON. L 900

TIME AND MOTION STUDY ENGINEERS.
Due to extensive expansion programmes BRIGGS MOTOR BODIES, LTD., require
Time and Motion Study Engineers with Industrial Experience to augment their present Work Standards Dept.
There are also a few vacancies for young men to undergo further training for positions in Work Standards Dept.
The posts are permanent and pensionable and there are excellent prospects for men of ability.
Applicants should write stating age and giving full details of career to:
Mr. J. A. BARKE, GENERAL MANAGER, BRIGGS MOTOR BODIES, LTD., DAGENHAM, ESSEX. L 883

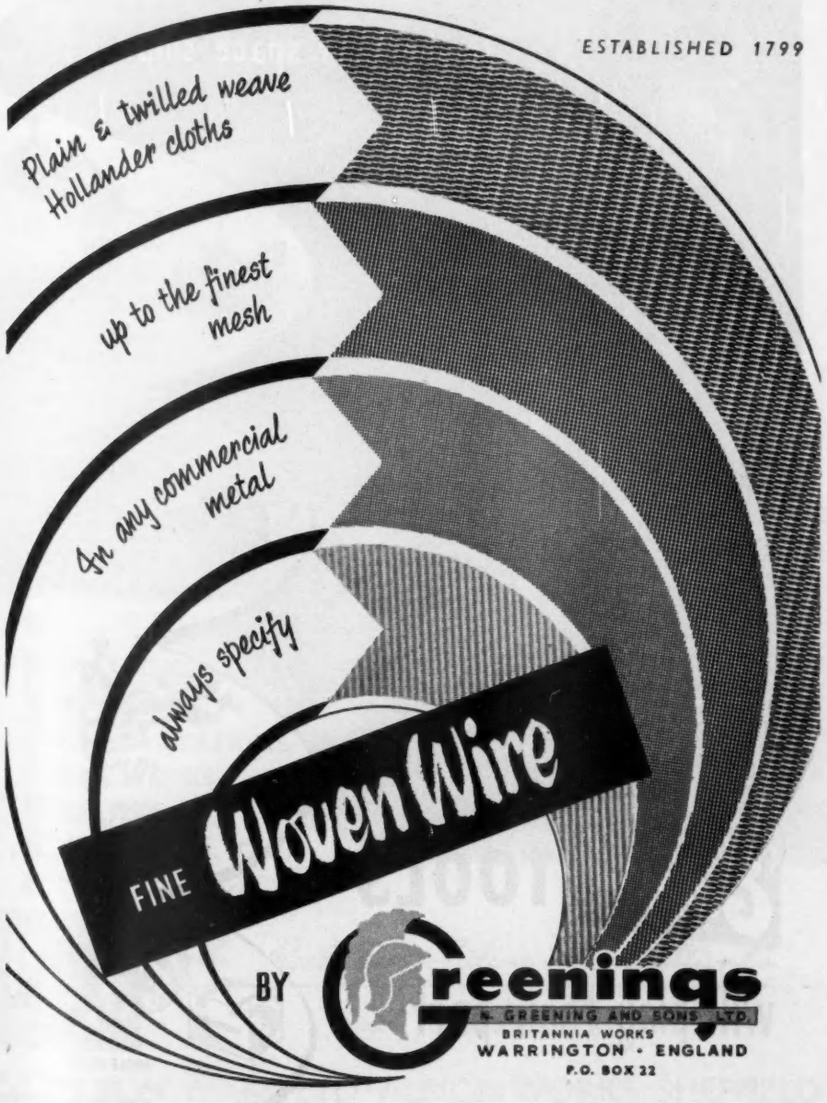
BRITISH INSULATED CALLENDER'S CABLES LTD.

wish to appoint a

SENIOR PLANT ENGINEER

to their Works Administration in Lancashire, controlling six factories.

Applicants should preferably be in the 30-45 age group and have a good degree in Mechanical Engineering; additional qualifications must include first class practical experience in factory plant, layout and services and the ability to initiate new ideas and introduce and administer the most modern engineering methods and practices. The appointment, which is pensionable, offers exceptional opportunity for advancement, with good remuneration appropriate to the qualification and experience. Applications in writing quoting reference P/35/56, should be addressed to the STAFF OFFICER, B.I.C.C. LTD., PRESCOT, LANCS. L 975


ESTABLISHED 1799
Plain & twilled weave Hollander cloths
up to the finest mesh
in any commercial metal
always specify
FINE Woven Wire
BY Greenings
& GREENING AND SONS LTD.
BRITANNIA WORKS
WARRINGTON · ENGLAND
P.O. BOX 22
Telephone: WARRINGTON 1901 Telegrams. GREENINGS, WARRINGTON
Also: BRITANNIA WORKS, HAYES, MIDDX. Telephone. HAYES 3961 Telegrams: GREENINGS, HAYES
NG 42

IMPERIAL CHEMICAL INDUSTRIES LIMITED.

METALS DIVISION.

Vacancies exist for

ENGINEERS

aged 27-36, to carry out design and development work on solid propellant rocket motors. Several years industrial experience, including workshop and drawing office training is essential, and the qualifications necessary are H.N.C., A.M.I.M.E. or an engineering degree. The posts afford interesting work in pleasant surroundings with good salaries and conditions of employment including profit sharing scheme.
Applications to: G.S.M., I.C.I. Metals Division, Summerfield Research Station, Kidderminster, Worcs.

L 922

A GRADUATE ENGINEER (MECHANICAL OR CHEMICAL) and a H.N.C. ENGINEER are required for fundamental work on the thermodynamics and combustion in diesel engines. Successful candidates will work with a group in the Research Department actively engaged in various aspects of diesel combustion. Enthusiasm and sound grasp of fundamentals more essential than previous experience in the field.—Apply to the PERSONNEL MANAGER, C.A.V. LIMITED, WARPLE WAY, ACTON, W.3, quoting Ref. R.23. L 921

DESIGN DRAUGHTSMEN. The British Drug Houses Ltd. invite applications from suitably qualified men for interesting work in their Engineers Drawing Office, on special machines and plant layouts for the Light Chemical Industry. Higher National Certificate in Mechanical Engineering and previous experience in this industry desirable but not essential. Men of mature age with suitable training and experience would be considered. Five-day week. Pension and Profit Sharing Schemes.—Write stating age, experience and salary required to STAFF MANAGER (REF. B8945), GRAHAM STREET, CITY ROAD, N.1. L 918

BRITISH PETROLEUM COMPANY LIMITED has vacancies for
MECHANICAL ENGINEERS in the MIDDLE EAST. Applicants, aged 25-32, must have served a full five-year engineering apprenticeship and possess either National Certificate or Diploma preferably at Higher level, or A.M.I.Mech.E. or 1st Class M.O.T. Certificate preferably with three years on maintenance work either in mills, mines or factories. Attractive salary plus generous allowance in local currency, free passages out and home, free medical attention, good eave arrangements. Pension Scheme, kit allowance, air-conditioned accommodation.—Write giving full details of qualifications and experience, quoting F.506A, to BOX 1802, c/o 191, GRESHAM HOUSE, E.C.2. L 912

PROGRESS ENGINEER.
A qualified Mechanical Engineer is required to take charge of requisitioning and progressing Mechanical and Chemical Plant from suppliers to sites. Experience in similar capacity is desirable and the post offers excellent opportunities for a man with initiative and drive. Excellent conditions of service, and commencing salary up to £1200 per annum.—Applications, with full details, to BOX L 956, Offices of ENGINEERING.

Classified Advertisements continued on Page 110

MAINTENANCE ENGINEER. A vacancy exists for a Maintenance Engineer on the permanent staff at a large sugar refinery. Experience in charge of mechanical engineering maintenance is essential and education must be to at least H.N.C. standard in Mechanical Engineering. Applicants who must be medically fit and aged not more than 45, should apply in writing, giving details of their career to the CHIEF ENGINEER, TATE & LYLE LIMITED, LOVE LANE SUGAR REFINERY, LIVERPOOL, 3. L 867

WANTED.

STEEL, ALUMINIUM, BRASS, SHEETS AND OFFCUTS, 10 to 24G. Small or Large quantities, Cash Payment.—DYAS & FOWLE, 41, LOUDOUN ROAD, N.W.8. MAL 2711, 5477. G 663

SURPLUS STAINLESS STEEL. Purchased Sheets, Strips, Bar and Tubes. Please quote sizes, finish and specification.—THE MULBERRY COMPANY, 223, St. John Street, London, E.C.1. Tel.: CLErkenwell 8356-7-8. G 455

2 TON CAPACITY OR NEAR STEAM DRIVEN DROP HAMMER required urgently for export.—BOX L 973, Offices of ENGINEERING.

PLANT FOR SALE.

COMPLETE SUB-STATION EQUIPMENT of fairly modern design, Owner having installed a larger Sub-Station, consisting of:—

3 Panel Truck type Switchboard.
One Incoming panel Airblast type.
Two Outgoing panels Airblast type.
Two 750-kVA Transformers.
Two medium voltage panels, one to each Transformer.

The above operating on 6000-6600-400-230 volts, 3 phase, 50 cycles.

The above equipment will be released in August, 1956, and was installed 1944.

Reply to THE CHIEF ENGINEER, BROTHERTON & COMPANY, LIMITED, CITY CHAMBERS, LEEDS, 1, for further particulars. L 968

LITERARY.

H. K. LEWIS & CO. LTD.

SCIENTIFIC AND TECHNICAL BOOK SELLERS.

A large selection of books on Engineering and Allied Sciences available. Catalogue on request.

LENDING LIBRARY

Scientific and Technical.
Prospectus post free on request.

Annual Subscription from 25s.

Bi-monthly List of New Books and New Editions sent post free regularly on request.

LONDON: H. K. LEWIS & Co. Ltd.
136, GOWER STREET, W.C.1.
Telephone: EUSton 4282 (7 lines). G 654

CAPACITY AVAILABLE.

FISHER FOUNDRIES, LIMITED, GREET BIRMINGHAM, for **MACHINE MOULDED PRECISION CASTINGS** in gun metal and soft grey iron. G 385

PRATCHITT BROTHERS, LTD., DENTON IRON WORKS, CARLISLE, having well equipped engineering shops and iron foundry, **INVITE ENQUIRIES FOR GENERAL ENGINEERING, STRUCTURAL AND PLATEWORK,** from firms wishing to have plant made to their own designs and specifications. G 511

DESIGN CAPACITY AVAILABLE

We have teams available to undertake design, detailing and development in the following fields:

Mechanical Engineering
Aeronautical Engineering
Special Machines and Projects
Servo Mechanisms and Automation
Mechanical Handling
Plant Layout
Production Tooling Etc.

The conception, design and development of **"BLUEBIRD"** was a special project undertaken by

NORRIS BROTHERS LTD.
53, VICTORIA STREET, S.W.1
— TEL. ABBey 5444 —
62, CHURCH ROAD
BURGESS HILL, SUSSEX.
TEL. BURGESS HILL 3656
G661

AGENCIES.

ENGINEERING AGENTS wide experience and excellent connections, are prepared to follow up quotation in the South Wales area.—BOX G 551, Offices of ENGINEERING.

WORK WANTED.

CONTRACT DRAWING OFFICE REQUIRES ADDITIONAL WORK, all types of Mech. & Struct. Design and Detail. A.B.A. TECHNICS, 1, Saville Place, Newcastle-on-Tyne, 1. L 672

FOR SALE.

OFFERED.

STEEL STORAGE BUILDINGS, HANGARS, GO-DOWNS, TROPICAL SHEDS, FACTORIES, ETC.—Write BELLMAN HANGARS, LTD., HOBART HOUSE, S.W.1. G 648

FOR SALE.

RECONDITIONED PIPING, SCREWED AND SOCKETED, READY FOR USE.

¾ in.	1,500 ft.	"B"
1 in.	1,500 ft.	"B"
1¼ in.	2,000 ft.	"B"
1½ in.	1,500 ft.	"B"
2 in.	5,000 ft.	"B"
2½ in.	780 ft.	"B"
3 in.	3,500 ft.	"C"
4 in.	3,000 ft.	"C"

Excellent Condition. Immediate Delivery.
MADEN & MCKEE LTD., 317, PRESCOT ROAD, LIVERPOOL, 13. L 866

FOR SALE.

M.S. ANGLES.
Unused, Stock Rusty.
1¼ in. by 1¼ in. by ⅛ ft.
Large quantity available.
Minimum 2 Ton Lots.
MADEN & MCKEE LTD., 317, PRESCOT ROAD, LIVERPOOL, 13. L 865

B.C.S.

TWO 16/20 H.P. RUSTON HORNSBY DIESEL LOCOMOTIVES, 24 in. gauge in first class condition.
3, CASTLE STREET, CARDIFF.
TEL.: CARDIFF 29246. L 869

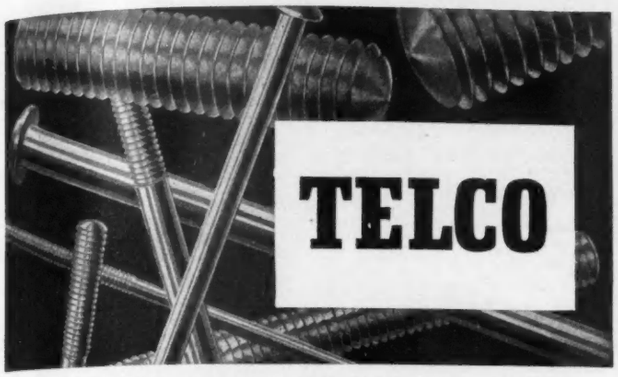
KORTING

MULTI-JET EJECTOR CONDENSERS
BAROMETRIC AND LOW LEVEL TYPES
(REQUIRE 'NO' AIR PUMPS)
FOR USE WITH VACUUM PANS, EVAPORATORS, ETC.
SPRAY COOLING PLANTS, SPRAY NOZZLES
STEAM AND WATER-JET APPARATUS FOR MOVING LIQUIDS, EXHAUSTING AND COMPRESSING AIR AND GASES, WATER HEATING, ETC.

Catalogues, Quotations and Technical Advice.
Free on Application.

KORTING BROS (1917) LTD.
SHEEPBRIDGE LANE, MANSFIELD, NOTTS.
Telephone: Mansfield 855. Telegrams: Korting.

In the first space ship .....
VEE BLOCKS
Six sizes from 3–8 inches wide in matched and numbered pairs. Also Vee Blocks and Clamps in hardened steel for the toolmaker and in cast iron for general use.
SWIVEL ANGLE PLATES
Low overall height gives maximum head room on machine. Inset swivel bolts permit use when stood on either end. Calibrated for indexing angularity.
VEE VICE
A dual purpose tool of unique design and with many special features providing a tool makers vice and, when reversed, a vee block and clamp.
ANGLE PLATES
A wide range of sizes available in webbed-end, open end and box types.
Eclipse TOOLS
will play their part
Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors



THREADED RODS AND HEADED RODS
Repetition Work • Nuts and Screws
TELCO LTD. 3 Newman Street London W.1 MUSeum 5701/4

Boots

LOCOMOTIVES

One secondhand 14 in. by 0-4-0 Saddle Tank Locomotive, in good working order, by ANDREW BARCLAY, 1947. Standard rail gauge, copper firebox and tubes. Tractive effort 14,300 lb., Boiler pressure 160 p.s.i.
One secondhand 15 in. by 0-4-0 Fireless Locomotive, in good working order, by ANDREW BARCLAY, 1930. Standard rail gauge. Tractive effort 9000 lb. Maximum storage steam pressure 150 p.s.i.

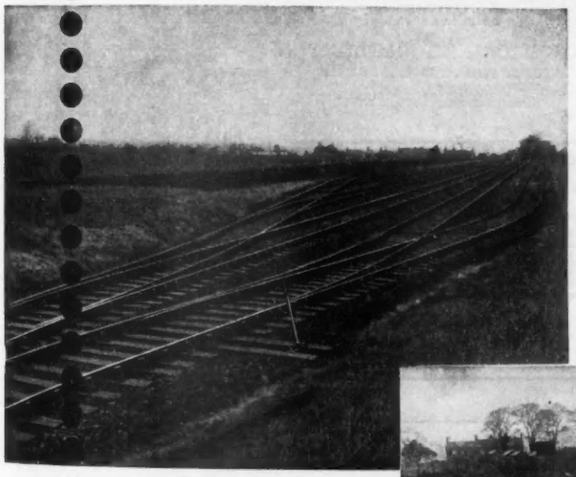
Messrs. BOOTS PURE DRUG CO. LTD.
Head Offices: 39, Station Street, Nottingham.
attention of Mr. R. D. Sykes, Engineering Dept.
L 952

B.C.S.

22,000 BABCOCK & WILCOX C.T.M. STEEL CASED WATER TUBE, 260 lb. with Superheater, Economiser by Green, Chaingrate Stoker. All mountings.
15,000 BABCOCK & WILCOX C.T.M. TYPE WATER TUBE, 180 lb., with Superheater, Economiser by Green. All mountings.
TWO 14,000 JOHN THOMPSON 4 DRUM WATER TUBE, 250 lb. with Senior Economiser. All mountings.
30 FT. BY 8 FT. 6 IN. LANCASHIRE by Yates & Thom, 160 lb. All mountings.
3, CASTLE STREET, CARDIFF.
TEL : CARDIFF 29246. L 890

WARDS *for Railway Sidings*

The service offered to industry by Wards is backed by the experience of over half a century, and covers every aspect of railway siding planning, construction and maintenance, including earth-moving and site preparation.]



The accompanying photographs show sections of a recently completed "Ward-built" siding.

Copies of the third edition of our booklet "Rails and Rail Accessories" forwarded on request.

COLLIERIES
REFINERIES
POWER STATIONS
GAS WORKS
BREWERIES
Ddocks, ETC., ETC.

TWW *The Railway Siding Consultants and Contractors*

THOS. W. WARD LTD · ALBION WORKS · SHEFFIELD
TELEPHONE: 26311 (22 LINES) • TELEGRAMS: "FORWARD • SHEFFIELD"
LONDON OFFICE: BRETTENHAM HOUSE • LANCASTER PLACE • STRAND • W.C.2
SC.33

TWW

RAILS FOR SALE

100 TONS NEW PERFECT B.H. RAILS, 95 lb. yard, chiefly 60 ft.
50 TONS NEW SLIGHTLY DEFECTIVE B.H. RAILS, 96 lb. yard, B.S.S., chiefly 60 ft.
100 TONS NEW SLIGHTLY DEFECTIVE F.B. RAILS, 109 lb. yard, chiefly 60 ft. lengths.
100 TONS GOOD SLIGHTLY SECOND HAND BULL HEAD RAILS, about 80/90 lb. yard, lengths 30 ft., 45 ft.
400 TONS NEW PERFECT F.B. RAILS, 75 lb. yard R.B.S., chiefly 45 ft. lengths.
50 TONS NEW SLIGHTLY DEFECTIVE F.B. RAILS, 80 lb. yard, Revised B.S. Section, lengths chiefly 40 ft.
50 TONS NEW SLIGHTLY DEFECTIVE F.B. RAILS, 80 lb. yard, OLD B.S. Section, chiefly 33 ft.
10/15 TONS NEW SLIGHTLY DEFECTIVE F.B. RAILS, 70 lb. yard, Revised B.S., chiefly 42 ft. lengths.
ABOUT 120 COMPLETE TURNOUTS, 24 in. gauge, made from 20 lb. F.B. Rails, mounted on steel sleepers, 15/16 ft. overall.
SWITCHES AND CROSSINGS, angle 1 in 8, Good Secondhand, 75 lb. F.B. Rails, B.S.S.
5 TONS SECONDHAND COACH SCREWS, ⅞ in. by 1¼ in., Standard Railway Pattern.
300 SECONDHAND C.I. CHAIRS, 81 Pattern, to suit 95 lb. B.H. Rails. B.S. Section.
WARD'S CAN SUPPLY NEW OR GOOD SECONDHAND SLEEPERS, CHAIRED SLEEPERS AND CROSSING TIMBERS, CAST IRON CHAIRS, SWITCHES AND CROSSINGS, BUFFER STOPS, TURNTABLES, OR IF PREFERRED, CONCRETE SLEEPERS COMPLETE WITH SUITABLE FASTENINGS.

THOS. W. WARD, LTD.,
ALBION WORKS SHEFFIELD
'Phone : 26311 'Grams : "Forward"
LONDON: BRETTENHAM HOUSE, STRAND, W.C.2.
'Phone: Temple Bar 1515 (12 lines).
Remember — Ward's might have it!
L 902

PEARSON

ELECTRO HYDRAULIC FLANGING PRESSES,
120 TO 500 TONS.
Robust all-welded construction incorporating the most modern developments.
T. B. PEARSON & SONS LIMITED,
WINCOMBLEE ROAD,
WALKER,
NEWCASTLE-UPON-TYNE, 6.
(Tel.: No. Wallsend 64081.) G 652

B.C.S.

ONE 600 K.W. SULZER DIESEL GENERATING SET, 220-440 volts, D.C., complete with Auxiliaries, Spares, etc.
ONE 850 K.W. SULZER DIESEL ALTERNATOR SET, 440-440 volts, 3 phase, 50 cycles, 428 r.p.m., complete with Auxiliaries, etc.
ONE 325 K.W. PAXMAN/CROMPTON PARKINSON DIESEL ALTERNATOR SET, 400-440 volts, 3 phase, 50 cycles, 1000 r.p.m., complete with Auxiliaries and Spare Parts.
ONE 80 K.W. GENERAL MOTORS/HOUCHIN DIESEL ALTERNATOR SET, 400-440 volts, 3 phase, 50 cycles, 1500 r.p.m., complete with all Auxiliaries and Switchboard.
ONE 55 K.W. MCLAREN/BRUSH DIESEL ALTERNATOR SET, 400-440 volts, 3 phase, 50 cycles, 1000 r.p.m., complete with Auxiliaries and Switchboard.
ONE 40 K.W. SENTINEL/LEROY DIESEL ALTERNATOR SET, 400/230 volts, 3 phase, 50 cycles, 1500 r.p.m., complete with Auxiliaries and Spare Parts. New 1951.
TWO 20 K.W. HILL & CO./DELCO DIESEL GENERATING SETS, 120 volt D.C., 1,450 r.p.m., complete with Auxiliaries.
3, CASTLE STREET, CARDIFF.
TEL.: CARDIFF 29246. L 889

MACHINERY FOR SALE.

10 FT. BY ¼ IN. CRAIG & DONALD PRESS BRAKE for sale. All steel construction, Model 400/10. Motorised with 50 h.p. motor suitable fo 400/3/50.—F. J. EDWARDS, LTD., 359, EUSTON ROAD, N.W.1. EUSton 4681 or 41, WATER STREET, BIRMINGHAM, 3. CENtral 7606.
L 924

TWW

PNEUMATIC HAMMERS.

3 CWT. MASSEY GUIDED TYPE WITH SLIDES, stroke 17 in., 160 blows p.m., baseplate 8 ft. by 3 ft.
2 CWT. MASSEY CLEAR SPACE TYPE, stroke 14 in., 200 blows p.m.; 12½ h.p. Induction Motor, 400-440/3/50 cycles, Starter, etc.
MASSEY ½ CWT. SPRING POWER HAMMER, approx. 320 blows p.m., 8 in. stroke; anvil pallet 12 in. by 7 in.; 3 h.p. S/C Motor, 400/3/50, Ellison Starter. Detachable anvil block.
60 LB. GOLIATH FORMING HAMMER, by Platt, 275 blows p.m., deals with 3½ in. dia. bars, 14 in. driving pulley.

THOS. W. WARD LTD.,
ALBION WORKS - - - SHEFFIELD
'Phone: 26311 - - - 'Grams: "Forward"
LONDON:
BRETTENHAM HOUSE, STRAND, W.C.2.
'Phone: Temple Bar 1515 (12 lines).
Remember — Ward's might have it!
G 60

EFCO 35 KW. ELECTRIC CARBURISING FURNACE, 20 BY 11 BY 24. Good condition (1951) c/w. pyrometer and recorder. £600.—BOX G.777, LEE & NIGHTINGALE, LIVERPOOL.
L 903

Classified Advertisements continued on Page 112

SOAG

OFFER

FOR IMMEDIATE DELIVERY

CRI-DAN
TYPE 'D'
HIGH SPEED — SEMI-AUTOMATIC
THREADING MACHINE

IN FIRST CLASS CONDITION

For full particulars, write to:
SOAG MACHINE TOOLS LTD., JUXON ST., LONDON, S.E.11.
Phone : RELiance 3373
Grams : Sotoolsag, London, S.E.11.
G230

"BRIGHTSIDE" FOUR-HIGH ROLLING MILL, complete with Coiling Equipment—16 in. Wide Strip down to 0.003 thick—Modern Plant in very good condition. Rolls 20½ in. by 9½ in. Speed 300/400 ft. per min.—BOX L 870, Offices of ENGINEERING.

Edwards

NEW SOENEN TYPE I.5 GEARED OPEN FRONTED INCLINABLE PRESS. Motorised 400/3/50. Pressure 120 tons. Stroke adjustable from 1 in. to 9⅝ in.

TWO NEW ALL STEEL PRESS BRAKES. Motorised 400/3/50. Capacity 8 ft. by ⅜ in. Stroke 3 in. Gap depth 18 in. With one set of vee forming tools.

NEW TRUMPF ELECTRIC THROATLESS SHEARING MACHINE, Model OMS.401/402. Motorised 400/440/3/50. Capacity 7 s.w.g. mild steel. Also suitable for polishing, grinding, fettling or wire-brushing.

NEW MUIR & BENDER ALL STEEL UNIVERSAL DOUBLE ENDED GEARED PUNCHING, SHEARING, SECTION CROPPING AND NOTCHING MACHINE, Model KBL.20. Motorised 400/3/50. Shears ½ in. plate. Crops 2½ in. rounds. Punches 1 in. by 1 in. Notches ⅝ in. Other sections in proportion.

BROOKES OPEN ENDED UNDERCRANK GUILLOTINE. Motorised 415/3/50. Adjustable gauges. Capacity 49½ in. by 16 s.w.g. Gap depth 2 in. Weight about 10 cwt.

WESTON DOUBLE SIDED FRICTION SCREW PRESS, Model 400/100. Welded steel plate build. Motorised 380/420/3/50. Pressure approx. 120 tons. Max. stroke 11 in. Dia. of screw with 4 starts 6½ in.

Photographs of the above are available.
MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.,
359-361, EUSTON ROAD,
LONDON, N.W.1.
Telephone: EUSton 4681-3771,
and at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606-7. G 552

FARMER NORTON CENTRELESS BAR TURNING MACHINES. Capacity 4 in. M.D. 400/3/50. With variable cutter heads, in and out-feed bogies.

H. BELL (MACHINE TOOLS) LTD.
WALTER STREET, LEEDS, 4.
Tel. 63-7398. G 649

SOAG

HIGH CLASS
LATE TYPE
HORIZONTAL BORERS
AVAILABLE IMMEDIATELY.

KEARNS "S" Type, with collet type spindle, motor drive, with separate motor for table feeds, table size 22in. by 16in., long. Table traverse 24in., cross table traverse 12in., vert. adjustment of spindle slide 12in., six spindle speeds 80-1,000 r.p.m.

KEARNS No. 1 Standard Type, motor drive, facing head only, max. facing cap. 20in., sliding table 33in. by 24in., revolving top table 24in. by 24in., max. distance facing head to outer stay 4ft., 24 speeds 4-300 r.p.m.

KEARNS No. 2 Patent Type, motor drive, with traversing spindle and continuous automatic facing head, main table with detachable quartering table, vernier scales, outer boring stay, spindle dia. 3in., facing capacity 30in., main table 48in. by 30in., auxiliary top table 36in. by 36in., 24 spindle speeds 3.1-250 r.p.m., h.p. of motor 5.

RICHARDS PRT2, motor drive, continuous feed facing head, power feeds and rapid power traverse in all directions, spindle dia. 3in., facing capacity 30in., max. traverse of spindle 48in., main table 48in. by 30in., revolving top table 36in. by 36in., 32 spindle speeds 3.5-300 r.p.m.

PEARN-RICHARDS No. 4 Standard Type-motor drive, facing head only, max. facing capacity 48in., sliding table 60in. by 36in., revolving top table 36in. by 36in., max. distance facing head to outer stay 7ft. 7in., 32 speeds 1.5-160 r.p.m.

SCHARMANN HB8F3, motor drive, facing head, power feeds and rapid power motion to table and spindle, screwcutting and verniers, dia. of spindle 4in., travel of spindle 31½in., facing cap. 39½in., boring capacity 19½in., working surface of table 47½in. by 55½in., max. distance spindle nose to outer stay 102½in., 24 spindle speeds 4.7-960 r.p.m., h.p. of motor 10.

NILES WV9 Floor Type Horizontal Borer, flanged motor drive, spindle dia. 3½in., facing head dia. 24½in., travel of spindle 31½in., travel of column 4ft. 4in., max./min. distance baseplate to spindle 60in./18in., 16 speeds 3-350 r.p.m.

Write for details on any of the above to:

SOAG MACHINE TOOLS LIMITED
JUXON STREET, LONDON, S.E.11.
'Phone: RELiance 3373.
'Grams: Sotoolsag, London, S.E.11.
G229

PENSOTTI 5ft. Motor Driven High Speed VERTICAL BORING MILLS

with taper turning and screw cutting attachment. Max. swing 62 in. dia. Rapid power traverses. 16 speeds from 4 to 145 r.p.m. Motor 28 h.p. Approx. weight 10 tons. 1951-2 machines in excellent condition.

F. J. EDWARDS LTD.,
359, Euston Road, London, N.W.1.
EUSton 4681 G 610

PATENTS.

THE PROPRIETORS OF BRITISH PATENT NO. 599283 for "SUSPENSION SHAFT FOR ROTARY CRUSHER" are prepared to enter into negotiations for the Sale of for the grant of Licences thereunder.—Enquiries to be addressed to CARPMAELS & RANSFORD, 24, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2. L 884

THE PROPRIETORS OF PATENT NO. 650967 for "IMPROVEMENTS IN OR RELATING TO A STAKING MACHINE" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. L 874

BRITISH PATENTS NOS. 656509 AND 656453. "IMPROVED TRACKLINE WHEEL AND METHOD OR AND MOULD FOR MANUFACTURING SAME"
and
"IMPROVED RAILWAY OR OTHER TRACKLINE WHEEL AND METHOD OF MAKING THE SAME."
OWNERS desire commercial exploitation on reasonable terms by licence or sale.
Enquiries:
H. D. FITZPATRICK & CO.,
CHARTERED PATENT AGENTS,
94, HOPE STREET,
GLASGOW, C.2,
and
3, GRAY'S INN SQUARE,
LONDON, W.C.1. L 910

NO. 691480. "DEVICE FOR PURGING BOILER WATER." The owners of the above patent are desirous of arranging by licence or otherwise on reasonable terms for the manufacture and commercial development of the invention.—For particulars address in the first instance to MATTHEWS, HADDAN & CO., 31 and 32, BEDFORD STREET, STRAND, LONDON, W.C.2. L 901

FOR HIRE.

LATTICE STEEL ERECTION MASTS (light and heavy) 30 ft. to 150 ft. high, for immediate hire. —BELLMAN'S, 21, Hobart House, Grosvenor Place, S.W.1. G 72

WHEN THINGS ARE WANTED FAST...

REMEMBER WARDS might have it!

THOS. W. WARD LTD.
ALBION WORKS, SHEFFIELD
G 550

COMPANY MEETING.

WORTHINGTON-SIMPSON, LIMITED

RECORD TRADING PROFIT

The sixty-fifth annual general meeting of Worthington-Simpson, Ltd., was held on June 5 at the Connaught Rooms, Great Queen Street, London, W.C., SIR SAMUEL R. BEALE, K.B.E., M.I.Mech.E., chairman, presiding.

The secretary (Mr. F. R. Bond) read the notice convening the meeting and the report of the auditors.

The following is the chairman's statement circulated with the report and accounts for the year ending December 31, 1955:—

The Report and Statement of Accounts that I have the pleasure to submit to you this year shows a record trading profit of £887,658 compared with £652,202 for 1954. After making provision for all charges, including taxation, the net profit for the year under review is £405,977 as against £296,112 for 1954. I feel that some explanation is necessary to indicate the cause of the considerable increase in profits over last year. The major portion results from increased sales and output of our established lines, coupled with increased sales from developments to which I referred last year; additionally we have been able to take profits on certain large contracts which have come to fruition during the year.

INCOMING BUSINESS MOST ENCOURAGING

I am pleased to report that our order book stands at about the same high level as last year and the incoming business for the first quarter this year is most encouraging.

You will see from the Balance Sheet that our capital commitments at £136,353 are considerably in excess of those at the end of 1954. The expenditure covers new machine tools, plant extensions and additional office accommodation.

Our policy for the time being is to enlarge our existing plant and manufacturing facilities at Newark to meet the increasing demands for our products but at the same time keep the rate of growth within our financial capacity and the availability of additional labour in the district.

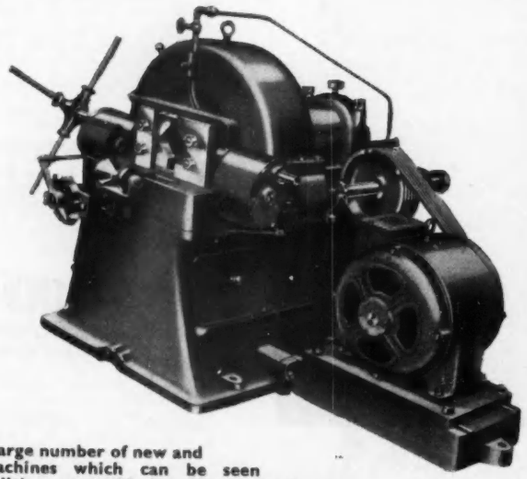
In closing I know you will once more wish me to take this opportunity of expressing your thanks to all those concerned for the excellent work which they have done during the past year and which I have no doubt they will continue to do in the coming year.

The report and accounts were unanimously adopted; the proposed final dividend of 10 per cent. on the Ordinary shares, making 20 per cent. for the year, less income tax, was approved; the retiring director, Mr. S. R. Williams was re-elected and the remuneration of the auditors, Messrs. George A. Touche & Co., was fixed.

For Immediate Delivery

TAYLOR No. 2 Motorised High Speed Cutting-Off Machines

Electrical equipment for 400/3/50. Hole through spindle 6¾ in. dia. Capacity for bars 2 in. to 4½ in. dia. for tubes 3 in. to 6 in. dia. Cutting times :— 3 in. steel bar 20 secs., 2 in. gas tube 7 secs., 4½ in. steel bar 50 secs., 4½ in. brass bar 35 secs. 3 in. copper tube, 18 secs., 6 in. steel tube 45 secs.



● **One of the large number of new and secondhand machines which can be seen under ideal conditions at our Modern Machinery Centre at Islington Park Street, London, N.1, near Highbury Corner.**

F. J. EDWARDS LTD.

359-361 EUSTON ROAD, LONDON, N.W.1.
Telephones: EUSton 4681 (7 lines) 3771 (4 lines)
Telegrams : Bescotools, Norwest, London.

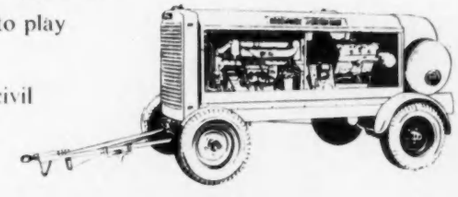
41 WATER STREET, BIRMINGHAM, 3
Telephones : CENtral 7606/7
Telegrams : Bescotools, Birmingham, 3

G653.

LONDON: HARRISON & SONS, LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

"BROOMWADE" serves the world

In the years gone by Beavers were the world's best dam builders.
Latterly, however, modern engineers have been
showing even the Beaver a thing or two in that particular field.
In the construction of vast dams for many of the world's
greatest hydro-electric and irrigation schemes,
"BROOMWADE" Air Compressors and Pneumatic Tools
have played, are playing and will continue to play
a vitally important part.
"BROOMWADE" serves the world in civil
engineering and in most other
fields of industry and engineering.

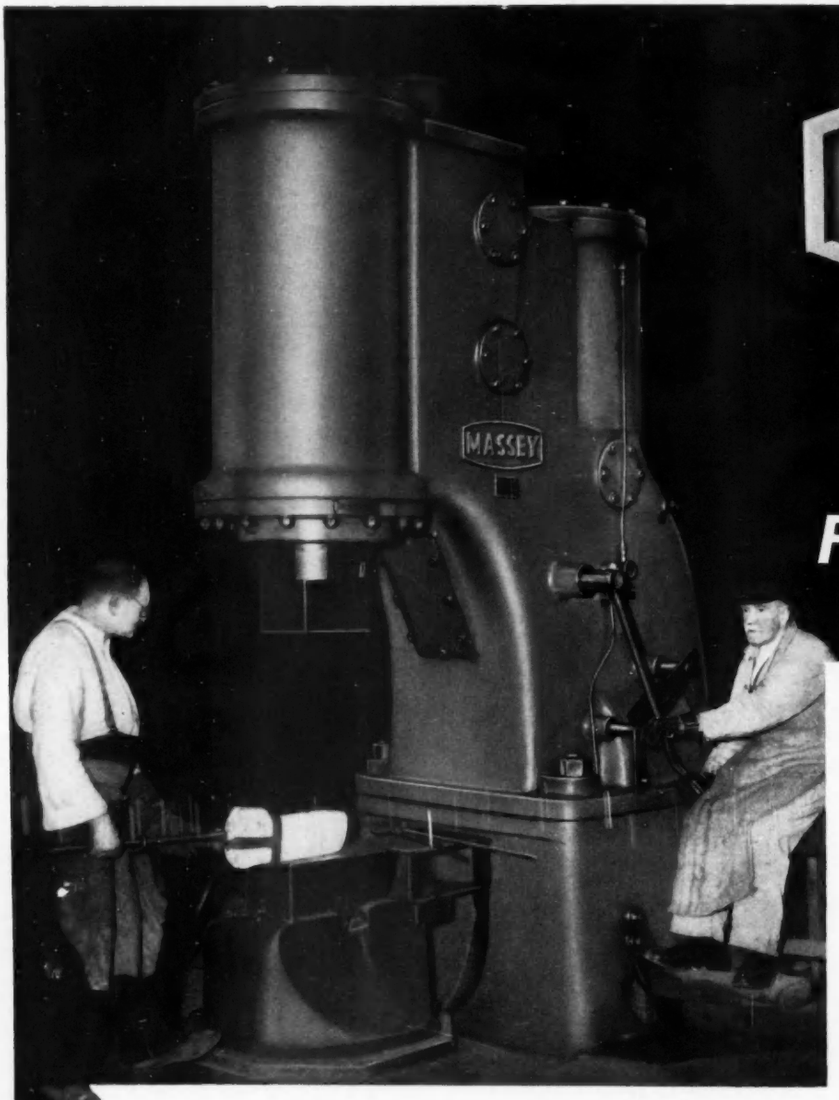


"BROOMWADE"

AIR COMPRESSORS & PNEUMATIC TOOLS

BROOM & WADE D., P.O. BOX NO.7, HIGH WYCOMBE, ENGLAND *Telephone: High Wycombe 1630 (10 lines) Telegrams: "Broom" High Wycombe*

367/S.A.S.

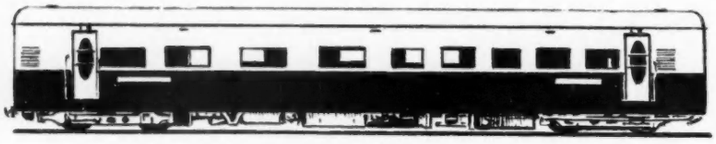


MASSEY

FOR FASTER FORGING

FOR RAILWAY TRANSPORT

Photograph by courtesy of Messrs. Cravens Ltd. Sheffield.



For high speed precision output of the various forgings used in the manufacture of rolling stock, Messrs. Cravens Limited rely extensively upon Massey Forging Plant. The Massey Pneumatic Power Hammer illustrated is forging crossbars for railcoach underframes and is also used for large scale production of spring bearing brackets and connecting hooks. Because of its versatility and economy in operation this type of Massey Hammer is ideal for any forge producing complex and intricate forgings to close limits of accuracy. It gives both automatic striking and fully controllable single blows at will.

MASSEY DESIGNS INCLUDE:

Steam and Compressed Air Hammers, Pneumatic Power Hammers, Spring Power Hammers, Friction Drop Hammers, Double-acting Steam and Compressed Air Drop Hammers, Forging Presses, Trimming Presses, Tyre Fixing Rolls.

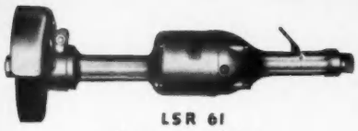
Visit us at Stand No. 33 at the International Machine Tool Exhibition 1956, June 22—July 6 Olympia, London.

B&S. MASSEY LTD. OPENSHAW · MANCHESTER · ENGLAND

MAKERS OF THE WORLD'S GREATEST RANGE OF FORGING PLANT

ASK THIS MAN

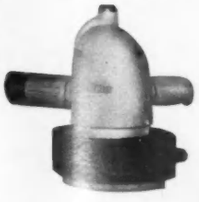
which air grinders he goes for, and he'll say



LSR 61
Heavy-Duty Grinder.

LSR 21
High-Speed Grinder.

LSR 11
High-Speed Grinder.



LSS 61
General-Purpose
Surface Grinder

LSS 81
High-Capacity
Disc Grinder.

* Atlas Copco – any time !

Remember the man that's got to use them when it comes to air grinders. He'd choose this Atlas Copco range. They're streamlined, light, simple to operate and *quiet*! He'd also go for the advanced safety features and the vane-type air motors with their *higher* power output. So next time you're buying air grinders, think of *increased* production, *lower* maintenance and running costs, and the man who'd work better with an *Atlas Copco* machine.

Give that man an Atlas Copco air grinder

Atlas Copco is the world's largest group of companies specialising in the development and manufacture of compressed air equipment. It embraces thirty-one Atlas Copco companies and twenty-four agents, manufacturing or selling and servicing Atlas Copco equipment in more than fifty countries.

WRITE FOR **FREE** *AIR GRINDER LEAFLETS AND DEMONSTRATION TO: Atlas Copco (Great Britain) Ltd., Beresford Avenue, Wembley, Middlesex, or your local Atlas Copco company or agent. If you have difficulty in finding their name, please write to Atlas Copco AB, Stockholm 1, Sweden.*

THE *Atlas Copco* GROUP OF COMPANIES

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

ENGINEERING

An Illustrated Weekly Journal

LANGITE

Langite — which for more than thirty years has been used so extensively wherever there is an oil joint to be kept tight — utilizes the natural resilience of cork, bonded together by an original process.

NEOLANGITE

like Langite, embodies cork, but in this case is bonded with appropriate synthetic rubbers.
NeoLangite is used extensively on transformers, aircraft, motor vehicles, etc.; it has a considerable mechanical strength and recovery after compression.

Chingford cork 'jointing' material

For less critical applications, cost may be saved by the use of this material, made alongside Langite but to a less exacting specification.
All other types of non-metallic seals, compressed asbestos fibre, impregnated paper etc. can be supplied.

CORK MANUFACTURING CO. LTD., SOUTH CHINGFORD LONDON E.4
Telephone: Silverthorn 2666 (7 lines)

LANGITE
JOINTING MATERIAL
RESISTS OILS, SPIRITS PETROL BENZOL ETC